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ABSTRACT

This report is the result of the statutory mandate by the National Commission on Libraries and Information Science (NCLIS) to promote activities to extend the nation's library and information handling capability as essential links in the emerging global information infrastructure. In a study to inventory the challenges related to libraries' roles in the National Information Infrastructure (NII), it was discovered that libraries had difficulty identifying and describing specific Internet costs. The cost elements, models, and worksheets presented here are intended to serve as useful guides for public libraries and communities in planning Internet connections and services. Five representative connectivity models and seven broad cost categories are identified for use by public libraries planning Internet connectivity and services. The value of this study rests more with the development of cost models, worksheets, and cost categories than with the costs represented in this report. However, the representative costs illustrate the significant variations that are possible in planning the networking permutations and configuration available to the public library community. For example, an initial one-time cost of $1,475 and a recurring annual cost of $12,635, a public library can establish a minimal level of single-workstation, text-based Internet connection. A more sophisticated representative multimedia connectivity model is described involving multiple workstations at multiple locations for a one-time cost of $266,375 and a recurring annual cost of $154,220, indicating the wide variation in cost and connectivity possibilities. The findings are intended to provide a basis for extending the benefits of advanced information services to the nation through its 9,050 public libraries. Models are illustrated through 14 figures. Two appendices provide research methodology and glossary of Internet terms. (Contains 14 references.) (Author/MAS)

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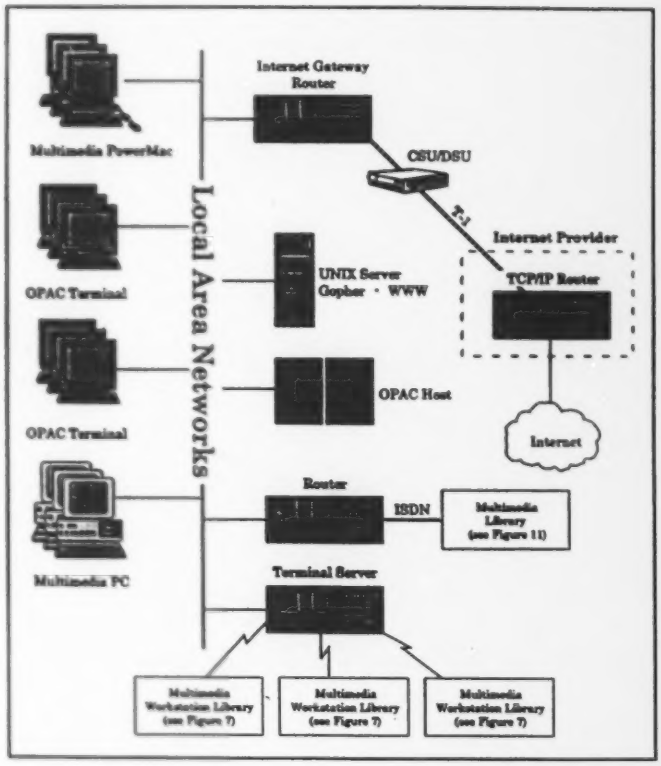
Internet Costs and Cost Models for Public Libraries



Final Report

June 1995

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Charles R. McClure • John Carlo Bertot • John C. Beachboard

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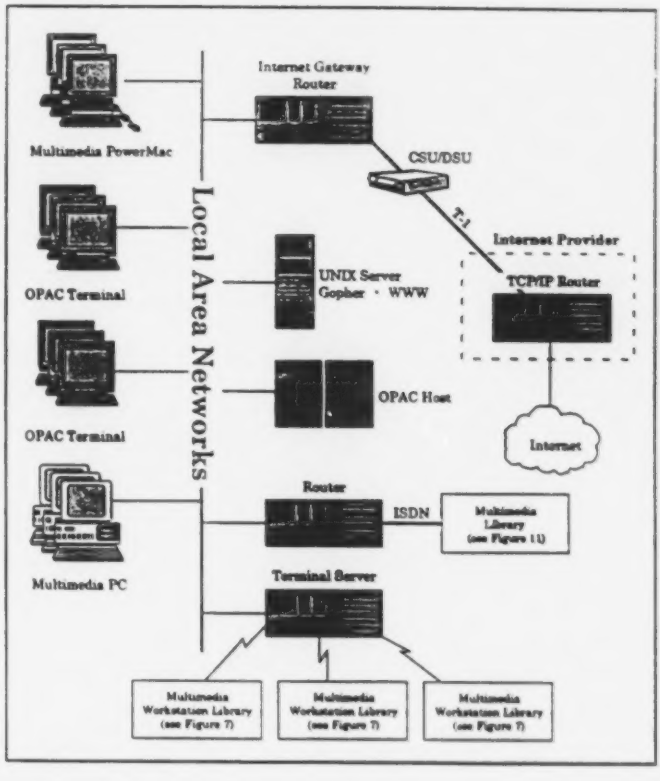

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United States
National Commission on
Libraries and Information Science

June 1995

The Honorable Al Gore, Jr.
Vice President of the United States
The Old Executive Office Building
Washington, D.C. 20501

Dear Mr. Vice President:

The members of the U.S. National Commission on Libraries and Information Science (NCLIS) are pleased to present this report on Internet Costs and Cost Models for Public Libraries. The report results from the Commission's statutory mandate to promote activities to extend and improve the Nation's library and information handling capability as essential links in the emerging global network infrastructure.

At a meeting at the Old Executive Office Building in July, 1994, you spoke to the Commission about the vision of the information superhighway. You called on NCLIS to inventory the challenges and respond to the questions related to libraries' roles in the National Information Infrastructure (NII).

Since meeting with you, the Commission has sponsored a study of Internet costs for public libraries. The project resulted from findings reported in Public Libraries and the Internet: Study Results, Policy Issues, and Recommendations which NCLIS issued in June, 1994. We found that 20.9% of public libraries were connected to the Internet. But we also found that public libraries had difficulty identifying and describing specific Internet costs. Public library respondents highlighted the critical need for additional reliable cost information to assist with Internet connectivity and in planning network services for the public.

The cost elements, models, and worksheets presented in this report are intended to serve as useful guides for public libraries and communities planning Internet connections and services. By identifying five representative connectivity models and seven broad cost categories, the report offers examples for use by public libraries planning Internet connectivity and services.

The value of this study rests more with the development of cost models, worksheets, and cost categories than with the representative costs presented in this report. However, the representative costs included in this report illustrate the significant variations that are possible in planning the networking permutations and configurations available to the public library community. The study shows that for an initial one-time cost of $1,475 and a recurring annual cost of $12,635, a public library can establish a minimal level of single-workstation, text-based Internet connectivity.

At a more complex level, the report describes a more sophisticated representative multi-media Internet public library connectivity model involving multiple workstations at multiple library locations for a one-time cost of $266,375 and a recurring annual cost of $154,220. The wide variation in total representative costs associated with Internet connectivity are an indication of the need for this type of study.

The Commission's examination of Internet costs for public libraries is based on the belief that these community information centers will comprise an essential component of the NII in the future. The findings of this study are intended to provide a basis for extending the benefits of advanced information services to the Nation through our 9, 050 public libraries. We look forward to working with you to extend your leadership in realizing the vision of universal service that will allow all Americans to take advantage of our rich resources in libraries, information, communication, and computing technologies.

Sincerely,

Jeanne Hurley Simon

Jeanne Hurley Simon
Chairperson

Foreword

P.L. 91-345 established the U.S. National Commission on Libraries and Information Science (NCLIS) to plan, advise, and offer recommendations to the President and Congress about libraries and information services. Over the last twenty-five years, NCLIS has supported numerous studies on information technology issues. Published reports of these studies explore the opportunities and potential for information technology and networks to enhance library service to the public. This report on *Internet Costs and Cost Models for Public Libraries* extends the Commission's work into this critically important area.

Recognizing the important impact of networked infrastructure developments on library and information services, the Commission's law was changed in 1991 to allow NCLIS to promote research and development activities to "...extend and improve the Nation's library and information handling capability as essential links in national and international communications and cooperative networks" (P.L. 102-95).

Recent advances in communications and network technology raise concerns about library roles in the future. To support planning, decision-making, and investment choices related to networks, library leaders and managers must have specific information to make informed choices. Also needed are new instruments to help librarians successfully navigate the challenges of an emerging networked information infrastructure. The library community requires new tools to provide the public with access to the advantages of advanced network technologies.

This report addresses the public library community's need for practical cost information related to Internet connectivity and services. The realization of the need for a preliminary study of Internet costs for public libraries results from the Commission's review of the findings reported in *Public Libraries and the Internet: Study Results, Policy Issues, and Recommendations*, published by NCLIS in June, 1994. While this study found 20.9% of U.S. public libraries were involved with the Internet, respondents reported difficulty in identifying and describing specific Internet costs. Public librarians highlighted the critical need for reliable cost information to assist with Internet connectivity planning and in developing networked library services for the public.

Peter R. Young, Executive Director
National Commission on Libraries and
Information Science

This report, *Internet Costs and Cost Models for Public Libraries*, is not a "how-to" manual for connecting public libraries to the Internet. The value of this study rests more with the development of cost models, worksheets, and cost categories that can assist public libraries determine an appropriate type of Internet connectivity and service provision given the library's need. The study seeks to improve the knowledge base of information, not to offer a comprehensive treatment of the topic.

Representative costs, however, included in this report illustrate significant variations involved in planning public library Internet connectivity and services. The networking permutations and configurations available to public libraries offer a complex array of choices.

The models developed in this study present possible alternatives for consideration at the institutional level. Because local circumstances, choices, and alternatives for Internet access and services vary significantly, the cost elements, categories, and models presented in this report provide illustrative examples, not implementation instructions. The wide variation in representative costs associated with public library Internet connectivity indicate the need for this type of preliminary study. But, because there is every indication that these variations and options will increase in the future, additional studies of this type are essential.

The Commission's examination of Internet costs for public libraries is based on the belief that these community information centers will comprise an essential component of the National Information Infrastructure in the future. The work that Dr. Charles R. McClure has done in preparing this study, along with his excellent work in directing the Commission's earlier survey of public libraries and the Internet, provides a valuable contribution to NCLIS and to the U.S. public library community. The Commission also commends the work of researchers John Carlo Bertot and John C. Beachboard for their work on this cost study.

With this report, the Commission offers a means to help librarians realize the vision of universal service that will allow all Americans to take advantage of access to the Internet, involvement with networked-based information services, and move into the global information infrastructure.

Acknowledgments

The members of the study team wish to thank the numerous librarians and other study participants who contributed their time, views, and experiences related to public library Internet costs and cost models. The participants came from all types of public libraries as well as from other organizational settings. It was their knowledge and experience that allowed us to develop the models and the cost worksheet. Because of their participation in the study other libraries will be able to learn from their experience and will be better able to plan for and provide Internet connections and services.

The support of the National Commission on Libraries and Information Science (NCLIS) was essential for the completion of this project. The direct involvement and leadership of Peter Young, Executive Director of NCLIS, contributed to the completion of the final report. His suggestions, comments, and guidance throughout the project also helped to ensure to the success of the project. The National Science Foundation (NSF) supported this project through Grant RED-9454732. Were it not for the support of NCLIS and NSF, this report could not have been written.

The able assistance of Beth Mahoney, Syracuse University School of Information Studies, in the design and production of the various graphics and figures was essential for the production of the report.

While we greatly appreciate all the assistance and support we received for this project, the content of the report is the responsibility of the authors alone.

Charles R. McClure
John Carlo Bertot
John C. Beachboard
June 1995

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Internet Costs and Cost Models for Public Libraries

Final Report

INTRODUCTION

During 1993 and 1994, The U.S. National Commission on Libraries and Information Science (NCLIS) sponsored research that surveyed the use of the Internet by public libraries. That project resulted in the report *Public Libraries and the Internet: Study Results, Policy Issues, and Recommendations* (McClure, Bertot, and Zweizig, 1994). The study produced the first national data describing public libraries' involvement with the Internet. The study also found that cost factors were extremely important in determining public libraries' connectivity to the Internet.

In one portion of the survey, respondents who reported having Internet connections estimated the costs for connecting to and using Internet-based services. Respondents, however, indicated difficulty in reporting such data. A number of libraries that reported that they were connected to the Internet were unable to identify and describe specific costs. Still others planning Internet connectivity indicated that they were unsure what types of expenditures to expect when connecting to the Internet or providing Internet-based services. Indeed, some commented to the study team that they were unable to plan their Internet connectivity because of the lack of information regarding Internet costs.

NCLIS published the report of the national survey in June 1994. At a meeting with Vice President Gore in July 1994, NCLIS discussed the roles of public libraries in the Internet/National Information Infrastructure (NII). In policy discussions regarding the role of libraries in the Internet held during the summer and fall 1994, a number of policymakers and librarians identified the need for additional information about the costs for public libraries to connect to the Internet and provide Internet-based services.

At the time, public library Internet connectivity cost data were largely unavailable. When available, cost data were anecdotal, taking the form of discussions and electronic postings through Internet-based listservs and newsgroups. As such, there was little systematic cost data, either by types of costs or actual costs incurred, available for public libraries interested in establishing Internet connections or developing Internet services.

Given the importance of the topic and the need for identifying and describing the various costs involved in connecting public libraries to the Internet, NCLIS expanded its work in this area. In February 1995, the Commission retained the study team to conduct a preliminary investigation to identify and describe public library cost elements for connecting to the Internet and providing Internet-based services. Information reported here follows from the original national survey to better identify and understand the costs associated with public library Internet connectivity and services. It also incorporates some findings from a study being completed by the authors for the National Science Foundation, *Policy Issues in Assessing the Role of Public Libraries in the Internet/National Information Infrastructure (NII)*.

The models and cost categories presented in this report are a first effort to define and describe typical costs related to public library Internet connectivity and related services. The study team expects that the identified cost categories, elements, and models can be further refined as they are used in the field. In addition to using study findings to better shape policy debates on the role of public libraries in the Internet/NII, the study team expects that the findings can assist librarians to better:

- Understand the nature and range of costs and issues associated with Internet connectivity and services.
- Plan for an appropriate level of Internet service given the various constraints and opportunities specific to a particular public library.
- Educate staff, the local community, elected officials, and governing bodies about connectivity options, configurations, alternatives, and costs.

Ultimately, such efforts can facilitate the public library community's transition to a networked environment and promote public access to the Internet/NII.

The purpose of the study was to improve the knowledge base of information about the costs for public libraries to connect to the Internet and provide Internet-based services. Specifically, the study objectives were to:

- Identify and describe a preliminary list of cost categories and elements for connecting public libraries to the Internet and providing Internet-based services.
- Develop alternative public library Internet connectivity cost models.
- Assist public librarians and policymakers to better understand the nature and range of costs and the different configurations available to public libraries for Internet connectivity and services.

This preliminary study is not a comprehensive treatment of the topic. Nor does this study provide a step-by-step manual on how public libraries should connect to the Internet. Rather, it begins to address the costing concerns identified by policymakers and public librarians. Appendix A describes the research methodology used to conduct this study.

The study does not provide a review and assessment of literature related to the Internet and public libraries or to costing Internet connectivity and services for public libraries. Readers who would like to review background information on these and related topics may wish to refer to McClure, Bertot, and Zweizig (1994); McClure, Moen, and Ryan (1994); and McClure, Babcock, Nelson, Polly, and Kankus (1994). Estrada (1993) published a very useful, although becoming dated, book that describes Internet connectivity options and service issues. Ryan (1995) has compiled an excellent annotated bibliography of sources related to building and managing Internet resources and services.

Appendix B is a glossary of terms related to telecommunications and the Internet. Although some of these terms are not explicitly mentioned in this study, the glossary is an excellent reference source for those needing explanations of terms related to the Internet, Internet connectivity, computing, and telecommunications. This glossary will be very useful for those librarians planning for Internet connections and services.

Due to the situational, and oftentimes unique, contexts in which libraries find themselves, the study does not seek to produce generalizable cost data for connecting public libraries to the Internet. The models and worksheets, however, should serve

as useful *guides* for libraries in a number of situations. The study does, however, identify the key costing elements and cost models associated with such elements in a general and usable form. Such data will inform the current policy debates concerning the role of public libraries in the Internet/NII, and they may assist public librarians to better plan and budget for Internet-related services.

TYPES OF PUBLIC LIBRARY INTERNET CONNECTIVITY AND INVOLVEMENT

This section presents an overview of some connection alternatives and levels of involvement. It also provides readers with a general context for considering alternative Internet connectivity options. The type of connection and level of involvement with the Internet that a library chooses will have a significant impact on the costs a library will incur. The connectivity models and cost worksheets depicted in this report attempt to capture these cost variances.

Types of Communications Connectivity

There are many approaches to connecting a library to the Internet. This makes comparing the offerings of Internet service providers through hands-on demonstrations and face-to-face discussion essential. A very useful source for current information about providers that offer connectivity and Internet-related services is the *Providers of Commercial Internet Access Directory* which is available from the World Wide Web (WWW) site <http://www.celestin.com/>. Librarians should keep in mind that in many areas of the United States Internet connectivity is a buyer's market, and the prices continue to drop.

It is possible to conceptualize Internet connectivity in several different ways. One useful approach is to compare dial-up versus leased line services. Dial-up access is typically associated with relatively low-speed (2400 - 28,800 bits per second) communications available using a modem with an ordinary phone line. However, ISDN (integrated services digital network) high-speed dial access is being implemented in some areas supporting 128,000 bits per second data transfer rates. Leased access is most often associated with leased point-to-point circuits that connect the user's location with the Internet provider's location or network.

Many new high-speed leased services are being introduced that may prove even more cost-effective: frame relay, SMDS (switched multi-megabyte data service) or ATM (ansynchronous transfer mode). These leased services vary greatly in capacity (speed of service), price, and how they are billed. Often there will be multiple communications charges assessed. For example, there may be a fixed monthly fee for the "local loop" — a point-to-point connection from the library's location to the vendor's service point-of-presence — and an additional monthly charge (fixed or variable) for the switched service.

There are many different terms that describe and define desktop computer hardware. For this report, the authors make two distinctions between desktop technologies: (1) terminals that are essentially dumb, that is, VT 100s that rely on a host for their computing power, and (2) workstations that are intelligent desktop computers, i.e., PCs, multimedia desktop computers, Macs, PowerPCs, etc. Such workstations can function in a stand-alone mode, as servers, or as other components of a network.

Dial-up Internet Connections

All of the communications alternatives referenced above can be configured to support a variety of Internet service requirements. However, low-speed and relatively low-cost dial-up access is typically associated with supporting either one or a small number of terminals/workstations. The equipment necessary for this type of connection includes a computer, a modem, and a phone line. Any type of computer will do, and most libraries will be best served by a modem that sends data at 14,400 bps or faster (although there are other lower modem speeds available). The phone line does not have to be "data grade," a regular voice grade line is usually adequate. If the line is "noisy," however, the library may not be able to connect at the highest speed the modem allows. The library will also need telecommunications software, which is usually bundled with your modem, distributed as freeware or shareware, or available at low cost. Three types of service often associated with dial-up access are:

- **Terminal Access (via vendor-provided host VT-100 shell accounts)**. The computer workstation runs software that allows it to emulate a terminal. The terminal accesses a vendor-provided host computer connected to the Internet. The Internet protocol known as TCP/IP stops at the host. Because TCP/IP does not come all the way to the computer workstation, the libraries will not be able to use graphical user applications such as Netscape or Mosaic with a terminal connection. Libraries will still, however, be able to use the WWW through text-based browsers like Lynx or "The Internet Adaptor" (TIA).

  Users also will not be able to use packet video teleconferencing, which requires TCP/IP all the way to the desktop. Users will, however, usually be able to use the entire Internet suite of tools: electronic mail, telnet, FTP, Gopher, WWW, and others. Pricing options include both flat fee with unlimited connect time and monthly charge plus connect time services.

- **Workstation SLIP (Serial Line Internet Protocol) or PPP (Point to Point Protocol) Access**. These types of connections give a computer workstation its own Internet address. In effect, this makes the computer an Internet host running TCP/IP. Unlike terminal access, SLIP/PPP allows libraries to use graphical Internet tools such as packet video teleconferencing and multimedia access to the WWW. SLIP and PPP connections have gotten easier to configure for those who use Windows or Macintosh operating systems. Several all-in-one packages support this type of connection.

  It is possible for multiple workstations on a local area network (LAN) to share a SLIP or PPP dial-up connection, allowing several users to access the Internet simultaneously. More than a handful of concurrent users will slow network speed to the point where it is of dubious value, however. Pricing is similar to that of terminal accounts, including both flat fee with unlimited connect time and monthly charge plus connect time models.

- **Internet Gateway Access (via commercial on-line provider)**. Some commercial on-line services (e.g., America Online, Prodigy, or CompuServe) offer users a graphical interface in front of a terminal connection to the Internet. Sometimes users have only an e-mail gateway. In other instances, users may be able to use the service provider's Gopher, but not use other, offsite gophers around the world. Or perhaps users will not have access to the WWW or FTP. Most of these types of dial-ups will not provide TCP/IP all the way to the desktop, so packet video and other applications requiring TCP/IP will not work in this configuration.

As ISDN services become available, dial-up connectivity will be able to support some of the more robust connection alternatives described below.

Leased Line Internet Connections

Leased line access describes a variety of communications services. This type of connection typically requires a dedicated point-to-point communications circuit from the service provider's network to the library. The library pays the telephone company (or other telecommunications provider) a monthly fee for this line plus initial installation charges. These charges will be in addition to the Internet charges levied by the Internet access provider. The lines come in various "speeds" or "bandwidth," such as 56K (56,000 bits per second) or T1 (1.5 million bits per second). The library will generally need some special "CPE" or customer premise equipment, called a CSU/DSU, to use this service. A special type of communications port may also be required for the library's computer or router.

This type of connectivity will almost always include TCP/IP, which will allow the library to run sophisticated software, use packet video, and operate Gophers or WWWs of its own. Generally there are no connect time charges, but this is not always the case. Computers connected to the library's local area network can use the Internet at the same time. Two common types of connectivity associated with leased line service are:

- **OPAC Gateways.** A number of on-line public access catalog (OPAC) vendors now include an Internet gateway as part of the OPAC. For example, a user at an OPAC terminal might hit <F4> and a menu of Internet services such as Telnet, FTP, Gopher sites, or other applications would appear. The user then selects the desired application from the menu. As with terminal

"shell" accounts, users are limited to text-based Internet tools (TCP/IP is usually not passed to the desktop). When graphical user interfaces (GUI) are offered, they are typically proprietary to the OPAC vendor.

Developments in this type of connectivity are occurring rapidly. Many new applications and gateways are appearing as of this writing. To some degree Internet-based OPAC gateways are a "turnkey" solution (providing both software and hardware) for libraries that may want connectivity and services without managing the connection directly themselves. Use of this type of connectivity, however, makes the library very dependent on the vendor and the degree to which the vendor will upgrade and support the system for the specific needs of the library.

- **Local Area Network (LAN) Access.** Many libraries have installed LANs to connect OPAC terminals to the OPAC host or to provide computer workstations with shared access to CD-ROMs. A library can install an Internet gateway router to connect these LANs to the Internet. Computer workstations can be configured to support TCP/IP and will be able to access the full range of Internet services via the LAN's gateway router. This configuration would also be capable of supporting Internet Gopher or WWW servers — making their content available not only to the local staff and patrons but to remote Internet subscribers as well. Libraries need to determine the capacity of their Internet connection by the number of simultaneous users supported and the types of services made available (multimedia users will require more bandwidth).

The configurations described above are representative Internet connectivity options. More detailed descriptions of the types of services and their corresponding hardware, software, and communications requirements are provided in the connection models described later in this report.

Levels of Internet Involvement

Given these basic connectivity approaches to the Internet, it may be helpful for the library to consider two levels of Internet involvement. The level of involvement chosen directly affects the costs and staff effort that a library will incur for providing Internet services:

- **Access to the Internet.** These are the costs associated with a library connecting to the Internet. These costs include such items as OPAC upgrades and the purchase of workstations/terminals to use for Internet access, modems/cabling for connectivity, the purchase of e-mail accounts (if required), monthly connection charges (flat rate or per hour), and telecommunications charges such as T1/dial-up costs, etc. The level of Internet access involvement might be further delineated to specify whether access will be limited to the library staff or extended to library patrons as well.

- **Internet Service Provision.** Many public libraries engage in Internet-based activities that go beyond basic Internet connectivity. Indeed, several public libraries provide Internet services — setting up Gopher or WWW servers, preparing and making available library-specific resources via the Internet (such as local/state history databases and images, legislative bill text) — that incur library costs. Such costs include research and development costs, staff costs, and technology costs in support of such services.

These types of connectivity and levels of public library involvement provide a planning framework within which library planners can identify specific cost categories and elements that are described below. Using this type of framework permits library planners to perform a general cost analysis of their library's future Internet access and services plans based on the level of Internet involvement desired.

COST CATEGORIES AND ELEMENTS

As a result of the data collection activities and techniques detailed in Appendix A, the study team identified cost categories and elements based on levels of Internet services provided. This section defines and details the cost elements based on the levels of Internet-based service provision categories discussed previously. The cost elements within particular categories, while not exhaustive, provide a framework for library managers and policymakers to plan for and monitor the public library Internet connectivity and Internet service provision process.

The cost worksheet (Figure 1), however, requires some preliminary explanation. The study team found that there exist cost categories and elements that are applicable to all public libraries currently accessing or in the process of connecting to the Internet. In addition, the data indicate varying degrees of public library involvement with the Internet, from those public libraries only gaining access now to Internet resources to those libraries actively providing Internet-based information services such as Gopher and WWW servers.

In general, the identified cost elements and categories cut across the various types of library involvement with the Internet. For example, one public library might purchase a workstation for public access to the Internet and another might use the workstation as a WWW server. The level of costs depends, in part, on the Internet connectivity models discussed in the previous section. To the extent possible, the study team attempted to identify the cost categories and elements associated with different public library levels of involvement with the Internet, as described previously.

The study team identified seven broad cost categories into which a majority of public library Internet costs fall. In this process, a cost worksheet was developed based on public library experiences reported to the study team. The cost worksheet allows for maximum flexibility to meet individual public library adaptation while highlighting the most important cost categories and elements. The cost categories with representative cost elements are:

- **System/Server Hardware**. Accessing the Internet/NII generally requires public libraries to acquire or retrofit computer system hardware — either to serve as workstations/terminals or Internet-based connection servers. In essence, connecting to the Internet/NII requires participants to develop or augment an existing technology architecture. Not only does this architecture have a technology component cost, but it also determines the level of service available to patrons and library staff.

- **Communications Hardware/Fees**. In order to access the Internet, public libraries minimally require an Internet service provider and a communications link to that provider — either a private-sector vendor, a publicly supported service (such as a state library network), or a link to some other service provider. There exist multiple Internet service programs to which public libraries can subscribe at varying rates — Internet access that requires hourly connect charges or unlimited access; per-account charges; fee-for-service charges (such as e-mail). In addition, public libraries can dial-up their Internet service providers or have direct connections through leased lines. Each connection method has implications for equipment requirements.

- **Software**. Using the Internet requires the acquisition and maintenance of a variety of software programs. The systems architecture of a public library will largely determine what software it needs for Internet connectivity. For example, if a public library decides to access the Internet through its OPAC, then the library may need to license that portion of the OPAC software. An OPAC-based Internet gateway might be bundled with Internet software navigation tools such as FTP, Telnet, and Gopher. If, however, such software is not included in particular OPAC purchased software, public libraries may incur additional charges for developing such Internet service capabilities. Workstation-based Internet access methods require a more comprehensive array to software selection, from operating systems (e.g., DOS/Windows, Windows NT, etc.) to navigation software (e.g., Netscape, Gopher, Lynx, etc.).

- **Training and Education**. Gaining access to and making use of Internet services requires that public library staff be trained in the use of information technology; systems design, support, and maintenance; Internet navigation; and methods incorporating Internet-based resources into existing and planned services. In addition, library staff must be prepared to help users with basic computer and Internet use, particularly when the library is one of the first institutions in its community to offer Internet access. Library staff should also be prepared to work with local and state government institutions that may turn to the library for their training needs.

- **Facilities Upgrades and Maintenance**. Although a simple, dial-up Internet connection requires only an electric outlet and a phone connection, some public libraries may lack even that. Many public libraries reside in buildings

with inadequate facilities — electrical, phone lines, cabling, air conditioning suitable for computer systems, space, office equipment and furniture — to support adequate Internet connectivity and programs. Depending on the state of a public library's building(s), libraries may require moderate to substantial renovations in order to provide a connection to the Internet.

- **Content and Resource Development**. Once connected to the Internet, public libraries find that they can make a variety of Internet-based services available to the Internet community. Such services might include digitizing unique collections and resources, creating an organizational framework for Internet navigation, developing other services as yet unavailable to users of the Internet, and, perhaps most important, maintaining and updating various content resources and directories available on the Internet.

  In addition, several study participants stated that they are now using the Internet to access commercial information services available from vendors such as Dialog and CARL. Interestingly, some librarians indicated that Internet-based commercial services are as reliable and cost the same or less than their CD-ROM-based counterparts. These services, however, may require special hardware, additional telecommunications charges, account costs, and service/usage charges.

- **Program Planning, Management, and Staffing**. Public library Internet initiatives often require significant planning efforts, including the development of a strategic plan that incorporates Internet access into library planning activities, the hiring of consultants, request-for-proposal (RFP) development and analysis, and vendor negotiations. Libraries may also find that the addition of Internet services requires a reallocation of current staff time and duties or, in some cases, the hiring of additional Internet-initiative specific staff (e.g., system administrators, network administrators, programmers).

- **Covered-Cost Items**. The research team found that many public libraries collaborate with a variety of local, state, and national institutions through which libraries receive numerous Internet-related items without direct cost to the library. For example, one medium-sized public library receives e-mail accounts from a local university. Another state library was able to use part of a state university's network backbone to provide Internet connectivity to some of its county library systems. In other cases, the county/state information services department houses and maintains library computer systems at no cost to the library. Each of these services has a cost that requires identification if *actual* costs describing Internet connectivity and services are to be accurate.

The above descriptions define the cost categories and elements referred to in the cost worksheet (Figure 1). In viewing the worksheet, users should keep in mind that it is the intersection of the cost elements and level of Internet involvement that largely determines the Internet-associated costs a library will incur when connecting to the Internet. The following connectivity models will demonstrate this more clearly.

PUBLIC LIBRARY INTERNET CONNECTIVITY MODELS

A model is an abstraction or representation of an item, like using a picture to represent an object. But just as a picture does not fully represent the object, a model, such as those provided here, cannot capture the richness of details that libraries encounter in planning Internet connectivity. The more successful libraries employing new technologies leverage their information technology investments by integrating Internet connectivity and services into their overall information infrastructure — such as their OPACS.

The alternative models presented here are not mutually exclusive. Readers can mix and match the different aspects of the models to meet the needs of their libraries' unique circumstances. Also, decisions are not irrevocable. Because technologies and services are evolving so rapidly, one can expect to make changes in even the most carefully planned systems. By proceeding with an incremental approach to Internet connectivity, a library can obtain the immediate benefits of the Internet while gaining valuable experience for planning future enhancements.

The models presented in this section focus the reader's attention on the *major components* to be considered in planning Internet connectivity. They

Figure 1. Cost Worksheet for Internet Connectivity Planning

Cost Categories and Elements	Quantity	Unit Price	Access to the Internet		Internet Service Provision	
			One-Time	Annual Recurring	One-Time	Annual Recurring
System/Server Hardware (Note 1)						
Terminals						
Multimedia Workstations (PC or Mac)						
Servers (PC, MAC, Unix, Commercial)						
Printers/Scanner						
Other						
Communications Hardware/Fees (Note 2)						
Telecommunications Lines (T1, ISDN)						
Routers						
Modems						
Telephone Lines (including toll charges)						
LAN Hubs and Transceivers						
Internet Provider Fees						
Other						
Software						
Operating Systems						
Applications Software						
OPAC Gateway						
Navigation (FTP, Telnet, Gopher, WWW clients)						
Site Licenses						
Other						
Training and Education						
Staff Training						
User Training						
Internet Training Positions						
Internet/NII Documentation Development						
Travel						
On-going User Support (e.g., Help Desk)						
Other						

Figure 1. Cost Worksheet for Internet Connectivity Planning (continued)

Facilities Upgrades/Maintenance						
Air-conditioning						
Cabling/Wiring						
Building Rennovation (training rooms, work areas)						
Office Equipment/Furniture						
Other						
Content/Resource Development						
Special Collections Development						
Resource Location/Organization Services						
Research and Development (unique resources)						
Commercial Services (e.g., Dialog)						
Other						
Program Planning/Management/Staffing						
Strategic Planning						
RFP Development/Analysis						
Consultant Fees						
Vendor/Provider Negotiations						
Personnel Time						
Program Analysis (e.g., Telecomm charges)						
Staff						
Other						
No-Cost Items (from other institutions, Note 3)						
Email Accounts						
Hardware						
Software						
Systems Maintenance						
Communications						
Training and Education						
Program Planning						
Consultants						
Facilities Upgrades						
Other						

Figure 1. Cost Worksheet for Internet Connectivity Planning (continued)

Summary Costs						
System/Server Hardware						
Communications Hardware/Fees						
Software						
Training and Education						
Facilities Upgrades/Maintenance						
Content/Resource Development						
Program Planning/Management/Staffing						
No-Cost Items (from other institutions)						
			One-Time	**Recurring**		
Total One-Time and Annual Recurring Costs						

Note 1 - In addition to purchase costs, additional charges associated with hardware may include installation, maintenance, or making upgrades to existing systems.

Note 2 - Communications costs include line (local loop) charges for Internet access, circuits to connect remote branches to the main library, hardware to serve the communications lines, as well as hardware associated with internal LANs. Again installation and maintenance costs must be considered. An extensive network may require the assistance of a telecommunications consultant.

Note 3 - The cost categories listed have been included to illustrate the wide range of support that may be available from local businesses, universities and user groups.

also encourage exploration and creativity and, as such, should not be treated as cookbook descriptions to be followed blindly.

Model Dimensions: Reach, Range, and Governance

Keen (1991) provides a useful means of describing an organization's information technology (IT) infrastructure. Rather than attempting to identify all of the relevant components of an IT infrastructure, Keen defines infrastructure in terms of its *reach* and *range*.

- Reach refers to the physical or geographic areas to which service is provided. It is very much a function of the communications components of an information system: those links that tie computers and terminals together.

- Range refers to the types of services available once connectivity is provided. For example, once a workstation is connected to the Internet, can users listen to sound files or are they limited to text-based services?

The reach and range of the information infrastructure that the library intends to provide will strongly influence the costs of the information infrastructure.

In addition, the dimension of *governance* is an important one when planning for Internet connectivity.

- Governance refers to organizational boundary spanning and the arrangements that are made across these organizations to manage the sharing of Internet costs and access. Such spanning may be a requirement to achieve the critical mass of resources necessary for implementing an effective and efficient Internet connection.

Librarians should explore the potential benefits from leveraging IT investments with other organizations in these fiscally austere times.

Reach (Geographic)

Reach, in terms of these Internet connection models, refers to how libraries connect to the Internet and how (from where) libraries serve patrons. Reach in this context refers to communications links both internal and external to library buildings. The internal reach refers to the location of public access terminals (whether workstations or *OPAC terminals*) within the library. Some libraries establish specific rooms or areas for their Internet terminals. Other libraries, primarily those that are able to provide Internet access via their existing OPACs, distribute Internet connectivity throughout the library by having their terminals attached to a Local Area Network (LAN), e.g., Ethernet LAN (see Figure 2).

Reach also refers to communications links that extend outside the building. Libraries require external connection to access the Internet. Reach can refer to multiple libraries or library branches being connected to share access to a single Internet gateway. Once one accepts the notion of connecting multiple libraries to share Internet connectivity, the reach can be further expanded to include support of other community access points such as schools, community centers, hospitals, and senior centers, as well as support dial-in access from residences and small businesses (see Figure 3).

Range (of Services)

Range refers to the types of Internet services that the library system supports. Not all Internet access configurations are equal. Connectivity is available for which there is access only to textual information and limited network navigation. A configuration may support network searching of text-based information (e.g., Gopher or Lynx) or access to graphic and multimedia information via the hypermedia capabilities of the WWW. Figure 4 describes the difference between text-based and graphical interface-based connectivity. A library can also choose to be an Internet information/content provider by supporting its own Gopher or Web server. Listed below are typical Internet service capabilities:

- **Text-based access.** Such access would occur via an Internet service provider host (often referred to as a shell account). A library would typically receive an e-mail account; have access to Telnet, FTP, Internet search software such as Gopher, Archie, Veronica, and Lynx; and, access to Usenet News. Shell accounts are typically provided to single terminal, dial-access subscribers, but contractual arrangements

Figure 2. Example Model of Internal Reach

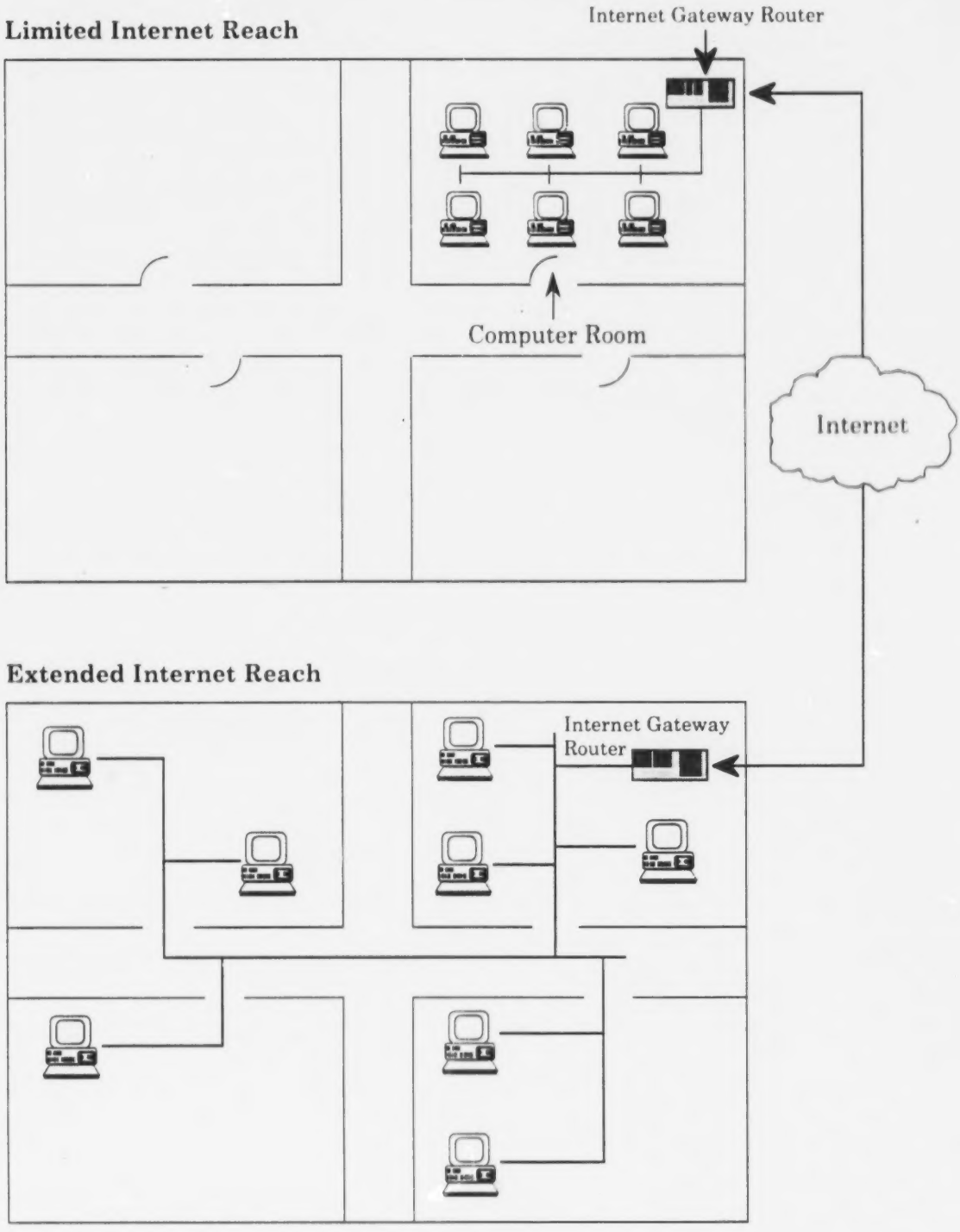
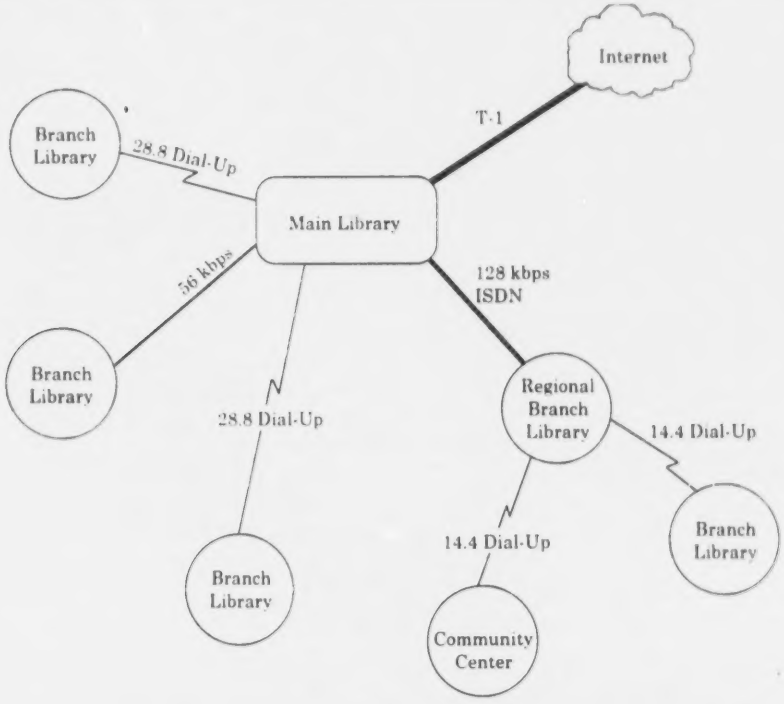


Figure 3. Example Model of External Reach



are available that provide multiple shell accounts to a library or to allow multiple users to share a single account.

- **Multimedia access.** This type of access comes from workstations that typically require TCP/IP access to the Internet. This type of service provides computer workstations with the ability to download, view, and listen to multimedia information. Workstations can directly support Internet navigation applications and vendor-provided shell accounts can be retained as well.

- **Internet Servers**. In addition to providing access to the information resources of the Internet, many libraries will want to make local information available. Full-time leased line Internet access is probably required if a library chooses to support server functions such as providing e-mail accounts or maintaining a Gopher or WWW server. Librarians should know, however, that it is possible to contract with a service provider or enter into a collaborative agreement with a local organization, e.g., university, to design and operate a WWW for them, off-site. A variety of communications arrangements exist to support full-time connectivity. Servers can be limited to providing text-based information services or configured to support dissemination of multimedia information.

- **Commercial Information Access**. In addition to the basic Internet services identified above, it is also possible to subscribe to commercial information services via the Internet (e.g., OCLC's FirstSearch, R. R. Bowker's *Books in Print*). Internet access is not required to obtain these services, but a library may find that the Internet provides more cost-effective access to such services.

A critical point to remember is that the services a library chooses to provide affect the terminals, hosts, and communications systems a library will need. Consider the following examples: a more powerful wokstation is necessary if libraries intend to access

Figure 4. Graphical Versus Text-Based WWW Interface

Welcome to the White House
An Interactive Citizens' Handbook
Welcome to the White House (p1 of 2)
WELCOME TO THE WHITE HOUSE
AN INTERACTIVE CITIZEN'S HANDBOOK
President's Welcome (
is ~408K, or text)
Guest Book
Vice President's Welcome (audio is ~143K, or text)
Executive Branch
First Family
Tours
What's New
Publications
Comments
Arrow keys: Up and Down to move. Right to follow a link; Left to go back.
H)elp O)ptions P)rint G)o M)ain screen Q)uit /=search [delete]=history list

the multimedia capabilities of the WWW; text-based access may be entirely adequate with a 9600 bps modem, but at least 14,400 bps and preferably a 28,800 bps modem is needed for downloading audio and video files (to individual workstations); a library might easily support 25 text-based Internet terminals with a 56,000 bps (56K) circuit, but a LAN connecting 25 active multimedia workstations will probably require a 1.54 million bps (T-1) circuit.

As resources are inevitably a constraint, librarians should realize that tradeoffs are possible between the number of subscribers supported and the range of services provided — reach as opposed to range. Librarians need to determine what services are most appropriate for a library's particular situation. Furthermore, libraries can mix the types of services they provide because every service does not have to be available at every location. It may possible to connect a limited number of high-end multimedia workstations (to build interest/demand) while providing the capability to support more simultaneous users via relatively inexpensive terminals.

Governance

Governance considerations in developing network connectivity are essential for leveraging resources. Funds, expertise, and even a critical mass of users may be lacking in any given library system. The technical architectures offered in this report do not recognize political boundaries. In most cases, Internet connectivity architectures can expand to support additional locations.

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Collaboration among various organizations provides more than an opportunity to share the cost of the Internet access hardware and circuits. It also provides an opportunity to share technical expertise, training, operational support, and the development of local information. Collaboration provides a potential source of synergy in which local resources can be leveraged to provide the collaborators with a wider range of services than a single organization might implement.

Public libraries receive their financial support primarily from local governments. This study identified, however, a variety of local governing models. Of special interest are rural library consortiums that pool the limited resources of their individual members to obtain access to a wider range of library materials. The rural consortium model of governance is intriguing because it might transfer to collaborative arrangements in urban or mixed urban/rural settings. Large urban libraries may be able to leverage their Internet connection investment by providing Internet access for surrounding rural communities. Cooperation between school districts, public libraries, community medical facilities, and other local government agencies might provide additional partners and the critical level of resources required to support advanced Internet services. In these instances, however, there is a need for innovative and flexible governance approaches to manage Internet connectivity and services.

Representative Connectivity Models

It is not possible to describe even a small percentage of the permutations and combinations of Internet connection configurations available. This report presents a limited number of models to illustrate possible configurations, the environments in which they would be appropriate, and some representative costs.

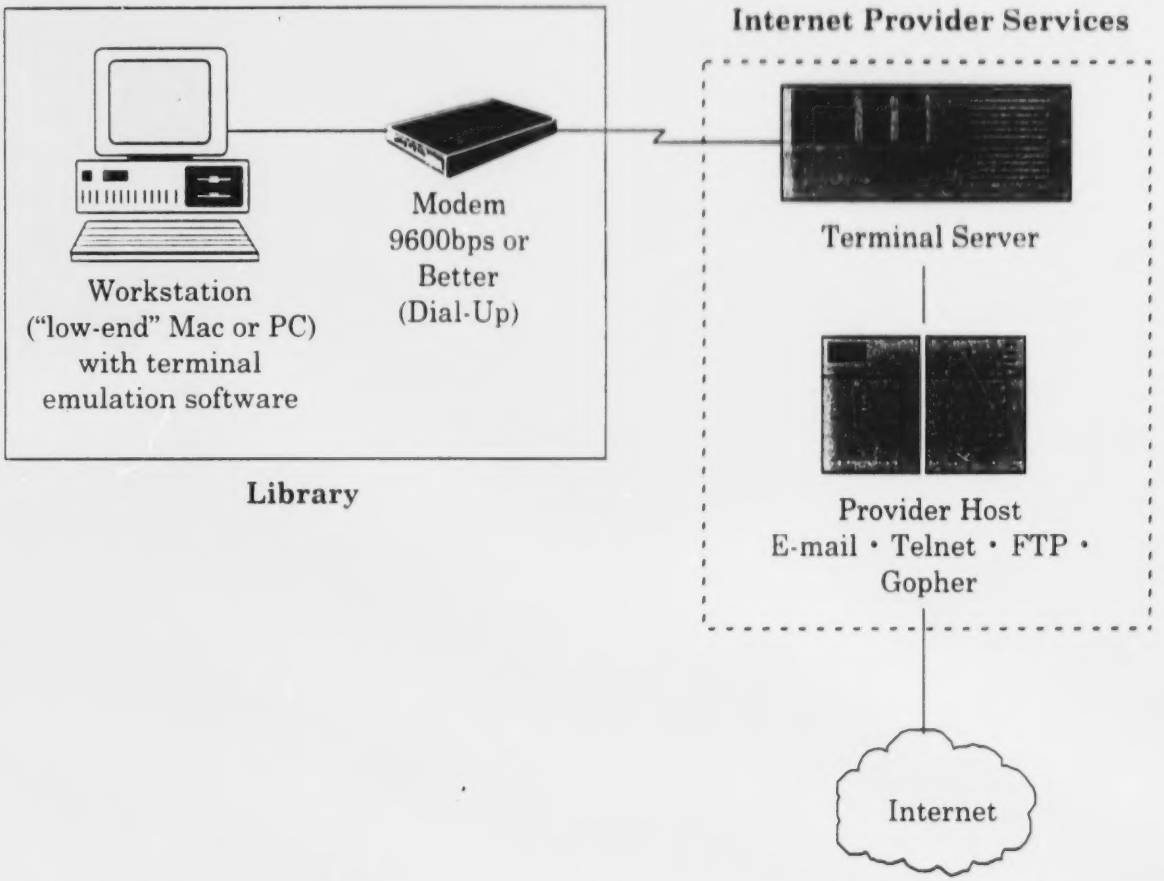
- **Single Workstation, Single Library, Text-Based.** A library can establish a minimal level of Internet connectivity relatively inexpensively. In this model, a library requires a single low-end workstation (such as a 286 or 386 compatible), a modem (2400-low speed, to 28,800-high speed, bps), a telephone line, and a shell account from an Internet provider. The communications software required to access the shell account is often bundled with the modem. Rural libraries face the greatest expense if they incur toll charges to access the Internet provider's nearest access point (often referred to as a point-of-presence (POP)). Minimal planning and installation costs are incurred and the workstation can be made available to staff and patrons. Figure 5 describes a model of this configuration. Figure 6 identifies typical costs for this configuration.

- **Single Workstation, Single Library, Multimedia**. More expensive computer workstation equipment, more complicated software and higher speed communications links are necessary to access multimedia information on the Internet. Much of the software, however, is freely available, and the costs of hardware continue to decline. Recurring communications costs associated with single terminal, multimedia access are generally equivalent to text-based services as dial-up lines are able to carry the 14,400-to-28,800 bps transmission rates required for acceptable performance in accessing and downloading multimedia files. Internet providers have been charging marginally higher costs for required TCP/IP (the type of communications protocol used to support multimedia service) connections, however. Figure 7 describes a model of this configuration. Figure 8 identifies typical costs for this configuration.

- **Multiple Terminals, Single Library, Text-Based**. Reach is extended by increasing the number of locations and subscribers that the system can simultaneously support. Relatively low-cost solutions exist to support this expanded level of service. Some technical assistance, however, is necessary. It is possible to configure a single workstation to support multiple terminals by adding serial communications ports and loading a multiuser operating system such as Unix or freeware such as Linux. Unix will allow the workstation to provide multiple low-cost access to a single Internet connection. Of course, the number of terminals that can be supported depends upon the power of the computer workstation and the capacity of the communications channel.

A low cost configuration such as that described in Figure 9 could easily support five simultaneous users as long as they access only text-

Figure 5. Single Workstation, Single Library, Text-Based Connectivity Model



based services. Figure 10 shows representative costs for this configuration. This configuration is functionally very similar to the text-based services being offered by many library OPAC vendors.

- **Multiple Workstations, Terminals, Single Library, Multimedia, with existing LAN and OPACS.** The combined expansion of reach and range implied by a library supporting multiple multimedia workstations and terminals is significant. The communications link between the library and its Internet provider must be larger as well as the links between the individual library workstations and the equipment (Internet router) located in the library that provides the Internet access. Rather than being an option, Local Area Networks (LANs) within the library become a requirement — although it is possible to support multiple single-workstation configurations by providing each its own dedicated phone line and access account.

When embarking on this more sophisticated level of service, time spent on planning and funds expended on professional consultation will generally pay real dividends — both in terms of the initial configuration and in terms of future expandability of the system. Planning may be complicated by the requirement and/or desire to effectively integrate these enhancements with an existing information infrastructure (e.g., a vendor-provided OPAC). The con-

Figure 6. Single Workstation, Single Library, Text-Based Cost Worksheet

			Access to the Internet		Internet Service Provision	
Cost Categories and Elements	**Quantity**	**Unit Price**	**One-Time**	**Annual Recurring**	**One-Time**	**Annual Recurring**
System/Server Hardware						
Workstation (Note 1)	1	$300	$300			
Inkjet Printer (including consumables)	1	$280	$280	$600		
Communications Hardware/Fees						
Telephone Line	1	$45	$45	$360		
Telephone Toll Charges (Note 2)				$6,500		
Modem (internal 9600 bps)	1	$80	$80			
Internet Provider Fees (Note 3)	1	$25	$25	$5,100		
Software						
Operating System (DOS bundled with PC)	1		n/c			
Communications Software (terminal emulation)	1		n/c			
Training and Education						
Staff Training (Note 4)	1	$150	$250	$25		
Public Training (materials)			$125	$50		
Facilities Upgrades/Maintenance						
Cabling/Wiring	1	$120	$120			
Office Equipment (stand and chair)	1	$250	$250			
Content/Resource Development						
Program Planning/Management/Staffing						
Staff Time						
No-Cost Items (from other institutions)						
Training (e.g., assistance from local user group)						

Figure 6. Single Workstation, Single Library, Text-Based Cost Worksheet (continued)

Summary Costs						
System/Server Hardware			$580	$600		
Communications Hardware/Fees			$150	$11,960		
Software			$0	$0		
Training and Education			$375	$75		
Facilities Upgrades/Maintenance			$370	$0		
Content/Resource Development			$0	$0		
Program Planning/Management/Staffing			$0	$0		
No-Cost Items (from other institutions)			$0	$0		
			One-Time	**Recurring**		
Total One-Time and Annual Recurring Costs			**$1,475**	**$12,635**	N/A for this configuration.	

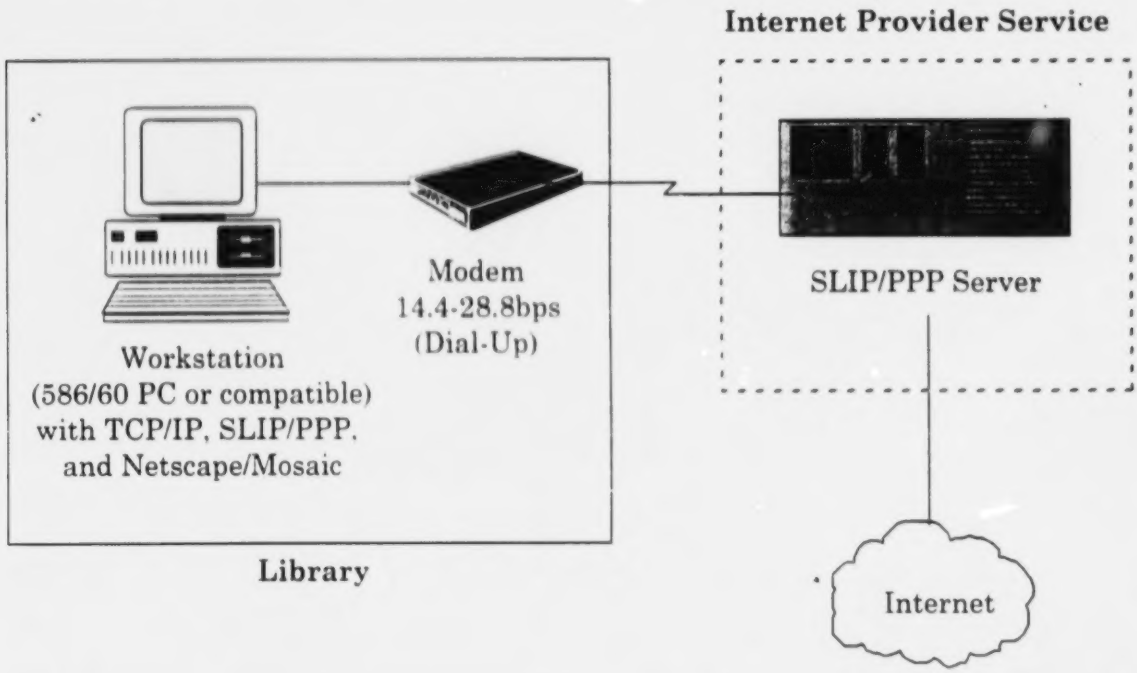
Note 1 - A low end workstation (286 PC or Macintosh) is adequate for text-based access. The cost provided is for a minimally equipped workstation — a 386 PC. If a new workstation is purchased, recommend purchasing one that will be capable of supporting multimedia applications. The cost of a multimedia workstation, however, will be greater — probably exceeding $2,000.

Note 2 - This configuration assumes a rural library. These costs reflect additional charges for 1440 hours of annual use of an Internet provider's 1-800 service.

Note 3 - This estimate includes a $30 per month connection fee and $3.00 per hour connection charge. Estimated usage is 1440 hours per year.

Note 4 - This configuration assumes minimal resources are available. Accordingly, limited funds are identified. The cost estimate reflects the purchase of several Internet guide books, reproduction of simple handouts, and a formal class for one librarian. Obtaining volunteer training from a local educational institution or hobbyist is recommended.

Figure 7. Single Workstation, Single Library, Multimedia Connectivity Model



figuration described in Figure 11 depicts how it is possible to integrate elements of a standalone multimedia Internet access capability with an OPAC Internet gateway configuration. Figure 12 identifies typical costs for this type of configuration.

- **Multiple Workstations, Terminals, Multiple Library, Multimedia.** It is possible to combine the above configurations into city, county, or regional multi-library configurations to minimize participating library information technology (e.g., OPAC system), Internet connectivity, and personnel costs. Additional components and increased system complexity, however, are associated with multiple library configurations. The central site will necessarily assume expanded technical responsibilities such as network management. A wider selection of communications alternatives requires evaluation, and system reliability takes on even greater importance.

Before attempting to implement such a configuration, a library needs to realistically assess its technical capabilities and determine whether the library requires outside expertise — for planning and implementation as well as follow-up operations. Qualified consultants cannot only save on the initial configuration expenses, but should also be able to plan and implement a system that can easily expand. Figure 13 depicts a model of this configuration. Figure 14 identifies typical costs for this configuration.

The above configurations provide the basic building blocks for establishing library Internet connectivity. It is possible to mix these constituent parts in a rich diversity of configurations tailored to meet the unique requirements of an urban center, a county system, or a consortium of public libraries and agencies. Moreover, libraries can begin with a small system that will evolve into something larger. Many of the individual components are upgradable

Figure 8. Single Workstation, Single Library, Multimedia Cost Worksheet

Cost Categories and Elements	Quantity	Unit Price	Access to the Internet: One-Time	Access to the Internet: Annual Recurring	Internet Service Provision: One-Time	Internet Service Provision: Annual Recurring
System/Server Hardware						
Workstation (Multimedia PC)	1	$3,000	$3,000			
Inkjet Printer (including consumables)	1	$280	$280	$900		
Communications Hardware/Fees						
Telephone Line	1	$45	$45	$360		
Telephone Toll Charges (Note 1)						
Modem (internal 28.8 kbps)	1	$220	$220			
Internet Provider Fees (Note 2)	1	$50	$50	$420		
Software						
Operating System (DOS Bundled with PC)			n/c			
Internet Shareware (TCP/IP, PPP, Netscape, Gopher, etc.) (Note 3)			n/c			
Training and Education						
Staff Training (Note 4)	2	$150	$500	$200		
Public Training (materials)			$150	$75		
Facilities Upgrades/Maintenance						
Cabling/Wiring	1	$120	$120			
Office Equipment (stand and chair)	1	$250	$250			
Content/Resource Development						
Program Planning/Management/Staffing						
Staff Time						
No-Cost Items (from other institutions)						
Training						

Figure 8. Single Workstation, Single Library, Multimedia Cost Worksheet (continued)

Summary Costs						
System/Server Hardware			$3,280	$900		
Communications Hardware/Fees			$315	$780		
Software			$0	$0		
Training and Education			$650	$275		
Facilities Upgrades/Maintenance			$370	$0		
Content/Resource Development			$0	$0		
Program Planning/Management/Staffing			$0	$0		
No-Cost Items (from other institutions)			$0	$0		
			One-Time	**Recurring**		
Total One-Time and Annual Recurring Costs			**$4,615**	**$1,955**	N/A for this configuration.	

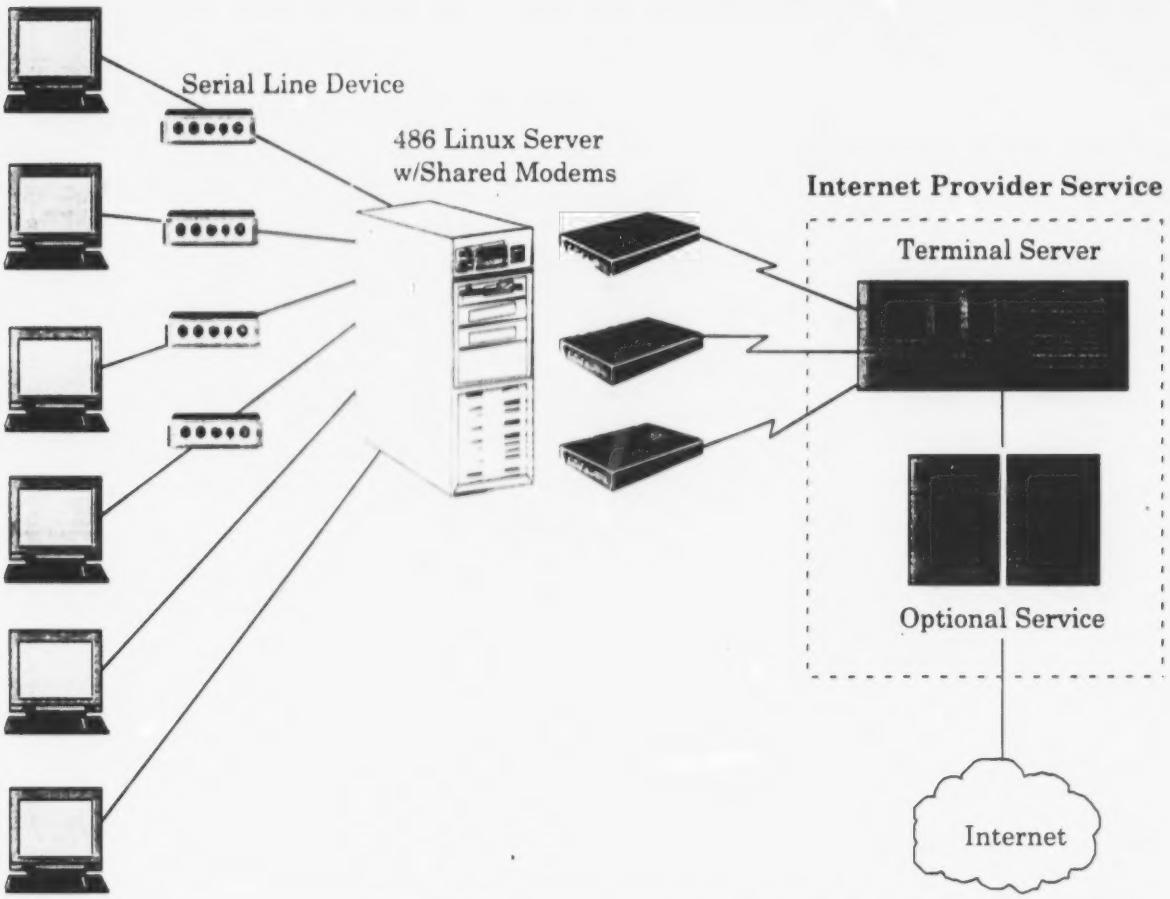
Note 1 - Toll charges required to reach nearest Internet Point-of-Presence (POP). This cost is site specific and this model assumes that the Internet POP is local, incurring no toll charges.

Note 2 - Internet providers will typically charge $30 to $40 per month for a SLIP/PPP account. These accounts may include unlimited access, or a specified amount of usage (e.g., 25 hours per month or 4 hours per day) with additional per hour charges of $3 to $4 when core hours are exceeded.

Note 3 - No costs for Internet navigation software are included as shareware is available on the Internet. However, some libraries may feel more comfortable using commercial software (e.g., Internet Chameleon, Internet-in-a-Box), which can be purchased for approximately $100 to $150.

Note 4 - These estimates include a limited number of commercial courses (@ $150 per individual per course), purchase of some books on the Internet and in-house preparation and distribution of training handouts for staff and patrons. Travel costs would be extra.

Figure 9. Multiple Terminals, Single Library, Text-Based Connectivity Model



so that libraries can increase the capacity of the system to meet growing requirements. When hardware does need to be replaced, it is often possible to reuse it at other locations.

USING THE MODELS AND WORKSHEET

Planning for public library Internet connectivity and services should not be done by luck or serendipity. As shown in this report, there are a number of specific costs and there are a range of alternative models that libraries can use for planning the level of Internet connectivity and services libraries will provide. Not all the costs and models can be known in advance, however, given local circumstances. Thus, developing Internet connectivity and services requires planning skills, knowledge of technology, political savvy, and a great deal of flexibility and adaptability.

The models and worksheet presented in this report should assist public libraries in their planning for Internet-based activities. The worksheet identifies the major cost elements that public libraries should consider, based on the level of involvement with the Internet that libraries desire.

Users of this report should view the worksheet and connection models as examples, and consider that local telecommunications, political, and other concerns will affect a public library's ability to

Figure 10. Multiple Terminals, Single Library, Text-Based Cost Worksheet

			Access to the Internet		Internet Service Provision	
Cost Categories and Elements	**Quantity**	**Unit Price**	**One-Time**	**Annual Recurring**	**One-Time**	**Annual Recurring**
System/Server Hardware						
Workstation (Multi-user, see Note 1)	1	$3,800	$3,800			
Terminals (e.g., OPAC-type terminals, see Note 2)	8	$200	$1,600			
Laser printer (including consumables)	1	$1,100	$1,100	$1,200		
Communications Hardware/Fees						
Telephone Lines	3	$45	$135	$1,080		
Telephone Toll Charges (Note 3)						
Modems (External 9.6-14.4 kbps)	3	$110	$330			
Serial Line Drivers (Note 4)	4	$75	$300			
Internet Provider Fees	3	$25	$75	$720		
Software						
Operating Systems-Linux (Note 5)			n/c			
Internet Shareware (E-mail, Telnet, FTP, & Gopher applications)			n/c			
Training and Education						
Staff Training (Note 6)	6	$150	$900	$600		
Public Training (Materials)	1	$250	$250	$150		
Facilities Upgrades/Maintenance						
Cabling/Wiring	1	$800	$800			
Office Furniture (Stands & Chairs)	9	$250	$2,250			
Content/Resource Development						
Program Planning/Management/Staffing						
Consultant Fees (Note 7)			$1,500	$500		
Personnel Time (Note 8)	1			$25,000		
No-Cost Items (from other institutions)						
Systems Maintenance						
Training and Education						
Program Planning						

Figure 10. Multiple Terminals, Single Library, Text-Based Cost Worksheet (continued)

Summary Costs						
System/Server Hardware			$6,500	$1,200		
Communications Hardware/Fees			$840	$1,800		
Software			$0	$0		
Training and Education			$1,150	$750		
Facilities Upgrades/Maintenance			$3,050	$0		
Content/Resource Development			$0	$0		
Program Planning/Management/Staffing			$1,500	$25,500		
No-Cost Items (from other institutions)			$0	$0		
			One-Time	**Recurring**		
Total One-Time and Annual Recurring Costs			**$13,040**	**$29,250**	N/A for this configuration. Note 9	

Note 1 - A workstation can be configured to support multiple users by addition of a serial port board (e.g., 16 port Boca Board @ $275) and installation of multi-user operating system such as Unix or Linux, a shareware version of Unix.

Note 2 - Any low-end used workstations or dumb terminals will work. The cost estimate reflects the cost of used 286s or low end 386s.

Note 3 - No costs for Internet navigation software are included as shareware is available on the Internet. However, some libraries may feel more comfortable using commercial software (e.g., Internet Chameleon, Internet-in-a-Box) which can be purchased for approximately $100 to $150.

Note 4 - Serial line drivers can provide a low cost solution for remotely locating terminals for their host.

Note 5 - Linux is a public domain version of Unix which has had useful Internet Navigation software written for it (e.g., Gopher clients).

Note 6 - This estimate reflects more extensive training requirements than the previous models. In addition to learning about the Internet, at least one library staff member will need to become familiar with basic Unix system administration.

Note 7 - A cost estimate for consulting support has been included to support the initial configuration of the system some limited follow-up support. It may be possible to obtain this type of technical assistance for free from an interested patron or from students working on the project as a class assignment.

Note 8 - With this configuration, a library should expect to dedicate approximately one staff year of effort to maintaining the system and providing staff and patron assistance. Travel costs associated with training have not been estimated.

Note 9 - This configuration is capable of supporting a limited server capability, that is, hosting a Gopher server or providing staff email accounts and/or dedicated leased access -- although some communications hardware would need to be switched out.

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Figure 11. Multiple Workstations, Terminals, Single Library, Multimedia Connectivity Model

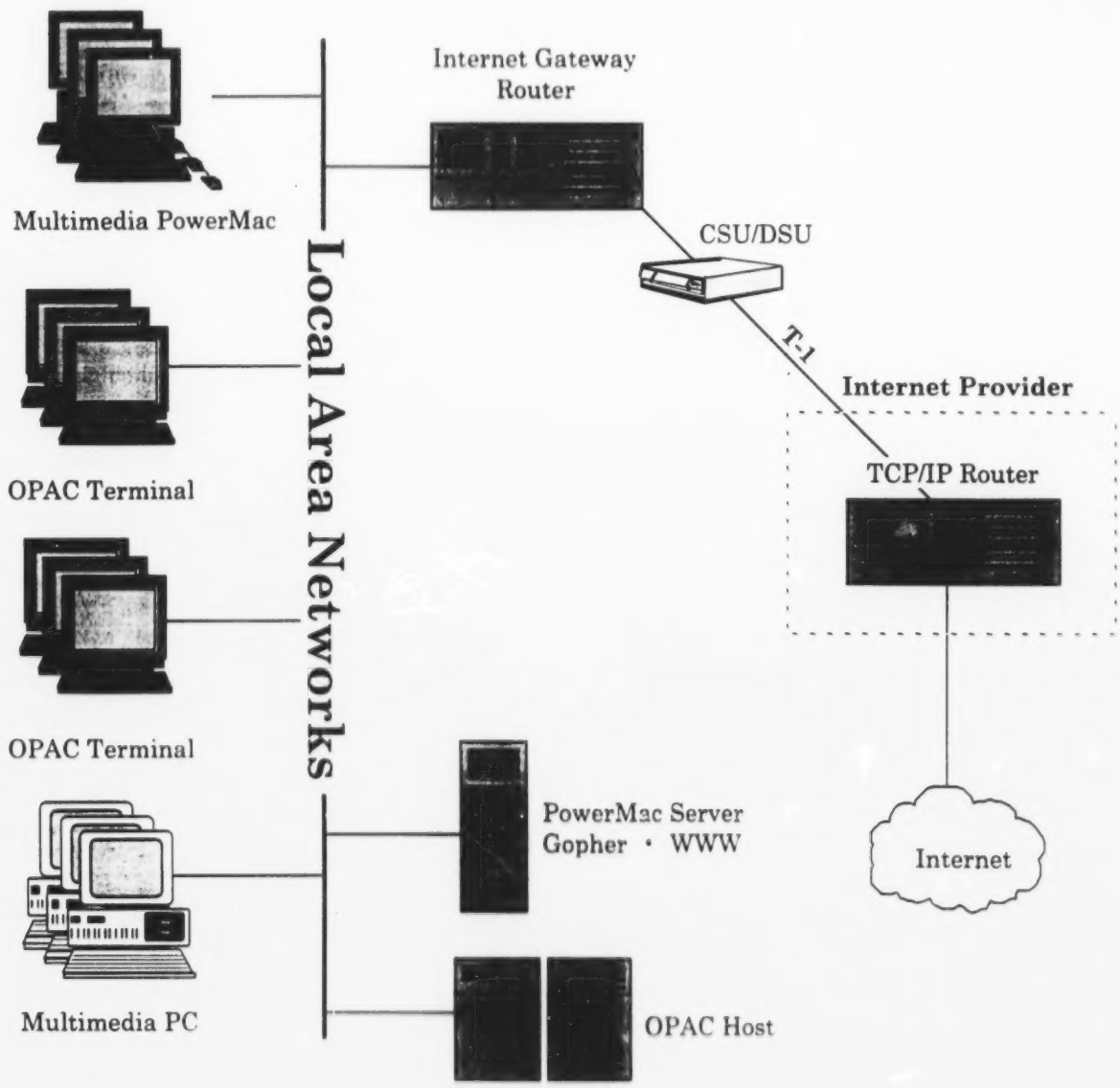

Figure 12. Multiple Workstations, Terminals, Single Library, Multimedia (With Existing LAN and OPAC System) Cost Worksheet

			Access to the Internet		Internet Service Provision	
Cost Categories and Elements	**Quantity**	**Unit Price**	**One-Time**	**Annual Recurring**	**One-Time**	**Annual Recurring**
System/Server Hardware						
Workstations (Multimedia PCs)	5	$3,000	$15,000			
Workstations (Multimedia PowerMacs)	6	$3,800	$19,000		$3,800	
PowerMac Internet Server (Note 1)	1	$8,500			$8,500	
Desktop Scanner	1	$900			$900	
Laser Printer (including consummables)	2	$2,300	$4,600	$2,000		
Hardware Maintenance (Note 2)				$2,200		$400
Communications Hardware/Fees						
Internet Access Line (T1)	1	$1,600	$1,600	$4,800		
Internet Gateway Router (Note 3)	1	$2,200	$2,200	$420		
CSU/DSU	1	$2,400	$2,400	$360		
PC Network Cards (transceiver)	5	$125	$625			
PowerMac Network Cards (transceivers)	5	$50	$250			
PowerMac (server) Network Cards (transceiver)	1	$1,300			$1,300	
16 Port 10Base-T Hub	1	$800	$800			
Print Server (to connect Laser to the LAN)	1	$700	$700			
Internet Provider Fees (T-1 service)				$22,000		
Software						
Operating Systems (bundled) (Note 4)			n/c			
Commercial Internet Navigation Software	11	$110	$1,100		$110	
OPAC Gateway	1	$5,000	$5,000			
Database Access Software (Note 5)					$1,000	$6,000
Tape Archival Software	1	$130			$130	
Gopher/Mosaic Server Software			n/c		n/c	
Training and Education						
Staff Training (materials)			$100		$500	
Public Training (materials)			$250	$300		
Internet Training Positions and Document Development	1	$25,000	$25,000	$600		

Figure 12. Multiple Workstations, Terminals, Single Library, Multimedia (With Existing LAN and OPAC System) Cost Worksheet (continued)

Facilities Upgrades/Maintenance						
Cabling/Wiring	1	$2,000	$2,000			
Building Renovation (training rooms, work areas)	1	$6,000	$6,000			
Office Equipment/Furniture	13	$250	$2,750		$500	
Server UPS	1	$440			$440	
Content/Resource Development						
Bowker's Books in Print						$8,000
Carl Uncover (Internet access) (Note 6)						$8,250
Program Planning/Management/Staffing						
Strategic Planning	0.25	$30,000	$7,500			
RFP Development/Analysis	0.25	$30,000	$7,500			
Consultant Fees			$3,000	$1,000		
Staff	1.5	$25,000		$25,000		$12,500
No-Cost Items (from other institutions)						
Training and Education						
Summary Costs						
System/Server Hardware			$38,600	$4,200	$13,200	$400
Communications Hardware/Fees			$8,575	$27,580	$1,300	$0
Software			$6,100	$0	$1,240	$6,000
Training and Education			$25,350	$900	$500	$0
Facilities Upgrades/Maintenance			$10,750	$0	$940	$0
Content/Resource Development			$0	$0	$0	$16,250
Program Planning/Management/Staffing			$18,000	$26,000	$0	$12,500
No-Cost Items (from other institutions)						
			One-Time	**Recurring**	**One-Time**	**Recurring**
Total One-Time and Annual Recurring Costs			**$107,375**	**$58,680**	**$17,180**	**$35,150**

Note 1 - A PowerMac 8150 with one gigabyte of disk storage has been included in this model to depict one technical alternative for providing a a local information server capability (both Mosaic and Gopher). This model assumes the existence of a library OPAC, thus, there are no cost estimates for OPAC terminals.

Note 2 - Maintenance contracts have not been recommended. However, funds should be set aside for repair or replacement of faulty equipment.

Note 3 - Router and CSU/DSU are provided, installed, and maintained by the Internet Provider.

Note 4 - The addition of 10 workstations could require the library to add additional user licenses for the network operating system (e.g., Novell).

Note 5 - Some Opac vendors have additional charges to provide software that supports access to external databases.

Note 6 - The Carl UnCover cost estimate includes $5000 for standard access via the Internet and 500 articles downloaded at a cost of $6.50 each.

Figure 13. Multiple Workstations, Terminals, Multiple Libraries, Multimedia Connectivity Model

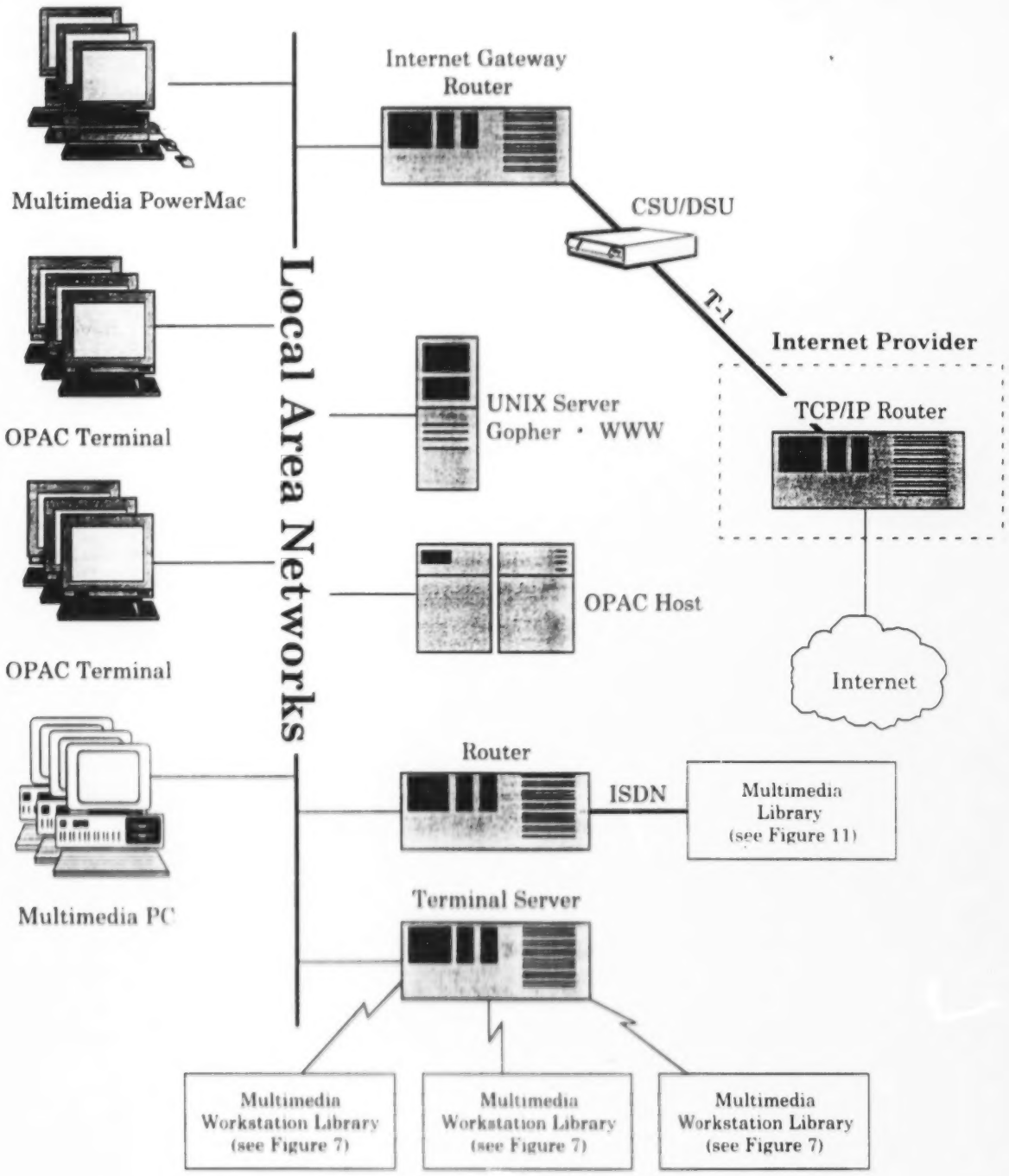

Figure 14. Multiple Workstations, Terminals, Main Library and Four Branches, Multimedia Cost Worksheet

			Access to the Internet		Internet Service Provision	
Cost Categories and Elements	**Quantity**	**Unit Price**	**One-Time**	**Annual Recurring**	**One-Time**	**Annual Recurring**
System/Server Hardware						
Workstation (Multimedia PCs)	19	$3,000	$54,000		$3,000	
Workstation (Multimedia PowerMacs)	19	$3,800	$68,400		$3,800	
Sparcstation 20 Internet Server (Note 1)	1	$32,000			$32,000	$3,240
Desktop Scanner	1	$2,200			$2,200	
Inkjet Printer (including consumables)	3	$280	$840	$2,400		
Laser Printer (including consumables)	3	$2,300	$6,900	$5,000		
Hardware Maintenance				$5,000		$500
Communications Hardware/Fees						
Internet Access Line for Main Library (T1)	1	$1,600	$1,600	$4,800		
ISDN Line (to connect the largest branch-128 kbps)	2	$600	$1,200	$2,400		
Telephone Lines (for the 3 small branches)	6	$45	$2,200	$3,240		
Internet Gateway Router (Note 2)	1	$2,200	$2,200	$420		
Modems (28 8 kbps)	6	$250	$1,500			
CSU/DSU	1	$2,400	$2,400	$360		
Terminal Server	1	$2,500	$2,500			
Bridge/Router (configured for ISDN)	2	$3,500	$7,000			
PC Network Cards (transceiver)	15	$125	$1,875			
PowerMac Network Cards (transceivers)	15	$50	$750			
16 Port 10Base-T Hub	3	$800	$2,400			
Print Server (to connect Laser to the LAN)	3	$700	$2,100			
Internet Provider Fees (T-1 service)				$22,000		
Software						
Operating Systems (bundled)			n/c			
Commercial Internet Navigation Software	38	$110	$3,960		$220	
OPAC Gateway	1	$5,000	$5,000			
Database Access Software (Note 3)					$1,000	$6,000
Gopher/Mosaic Server Software (shareware)			n/c		n/c	
Training and Education						
Staff Training (materials)			$300	$600	$500	
Public Training (materials)			$750	$1,000		
Internet Training Positions and Document Development	1	$25,000	$25,000			

Figure 14. Multiple Workstations, Terminals, Main Library and Four Branches, Multimedia Cost Worksheet (continued)

Facilities Upgrades/Maintenance						
Cabling/Wiring	1	$3,000	$3,000			$500
Building Renovation (training rooms, work areas)	1	$8,000	$8,000			
Office Equipment/Furniture	41	$250	$9,500		$750	
Server UPS	1	$440			$440	
Content/Resource Development						
Bowker's Books in Print						$8,000
OCLC FirstSearch (Internet access) (Note 4)						$29,250
Server Administrator	1	$30,000				$30,000
Program Planning/Management/Staffing						
Strategic Planning	1	$30,000	$30,000			
RFP Development/Analysis	0.5	$30,000	$15,000			
Consultant Fees			$8,000	$1,000		
Staff	4	$30,000		$120,000		$12,500
No-Cost Items (from other institutions)						
Training and Education						
Program Planning						
Summary Costs						
System/Server Hardware			$130,140	$12,400	$41,000	$3,740
Communications Hardware/Fees			$27,725	$33,220	$0	$0
Software			$8,960	$0	$1,220	$6,000
Training and Education			$26,050	$1,600	$500	$0
Facilities Upgrades/Maintenance			$20,500	$0	$1,190	$500
Content/Resource Development			$0	$0	$0	$67,250
Program Planning/Management/Staffing			$53,000	$121,000	$0	$12,500
No-Cost Items (from other institutions)						
			One-Time	**Recurring**	**One-Time**	**Recurring**
Total One-Time and Annual Recurring Costs			**$266,375**	**$168,220**	**$43,910**	**$89,990**

Note 1 - Estimate is for a Sparcstation 20 with 128 MB RAM, 5.2 GB disk storage, CD-ROM, tape backup system, and LAN transceivers. The Sparcstation is for use both as a Gopher and as a Mosaic server.

Note 2 - This cost estimate is based on a configuration that includes a main library and four branches. There is an existing OPAC in the main library. Costs for equipment and communications to provide the branch libraries access to the OPAC and Internet are included. The largest branch includes a LAN that is connected to the main library with an ISDN 128 kbps circuit. The other three branches are connected with 28.8 kbps dial-ups.

Note 3 - Some OPAC vendors have additional charges to provide software that supports access to external databases.

Note 4 - OCLC FirstSearch base package subscription price for six simultaneous logons. Access via the Internet saves $9.60 per hour logon time via WATS lines.

connect to and interact with the Internet. The authors of this report expect that public libraries will modify and adapt the models and cost worksheet in this report to their particular situations. As such, this report is really a beginning point for a library's Internet initiative rather than a "how to" guide, and serves to assist public libraries make the transition to the Internet.

Three key points the reader should draw from this discussion of connectivity models and costs are:

- It is not necessary to start with an elaborate and expensive configuration for connecting a public library to the Internet. Indeed, significant benefits and learning opportunities are attainable with relatively modest investments.
- Creative use of collaborative partnerships can leverage even modest technology investments to provide higher levels of service to a library's patrons and community.
- The actual models and costs for any particular library situation will vary considerably depending on the library, its current situation, and a range of additional factors.

Although the worksheets and models offer realistic examples of costs and technical architectures associated with providing various levels of Internet service, they are not fully engineered solutions and therefore do not identify every specific cost that a library can encounter.

Many costs, such as communications and building upgrades, are necessarily a function of a library's specific situation and the available service providers. Keep in mind the following when using these models and worksheets:

- **More is generally better when purchasing workstations and servers.** Users will be more satisfied with a bigger monitor (and faster/higher resolution graphics card), a faster processor, more computer memory and bigger communications channels. This is particularly true with regard to multimedia systems. More powerful systems will also tend to have a longer useful life. There is a tradeoff, however, between the cost of each workstation and the numbers that libraries can afford. If a library has to trade computer workstation power for numbers of workstations (reach for range), pursue reach. Technology is evolving and costs continue to drop. At this stage it may be beneficial to support more patrons than to invest in the more expensive multimedia capabilities.
- **Planning the communications components of an information infrastructure is technically challenging.** Although no decisions are irrevocable, some early decisions regarding the selection of telecommunications hardware and software may seriously impact upon a library's future ability to grow its network. Local telecommunications vendors may be willing to assist in the required planning, but libraries should critically review this assistance. For major projects, if in-house expertise is not available, libraries should hire a telecommunications consultant. If resources are not available, it may be possible to get technical assistance from a local university or local government officials.
- **Selecting software can pose additional challenges for the Internet planner.** There is a variety of "freeware" and "shareware" available. However, some libraries will prefer to use commercial products for which (generally) more complete user documentation and technical support is available. Unfortunately, the libraries that are best able to afford commercial software are the most likely to have dedicated technical staff capable of finding, evaluating, and using shareware. There is no simple solution to this problem. We can only suggest that if the budget is extremely tight, look for support from local computer hobbyists or professionals.
- **Cost estimates related to staff workload are not as specific as the study team would like.** The project can consume many staff hours for planning, coordinating, implementing, training, and assisting patrons. The sites visited by the study team indicated as much but they were generally not able (or willing?) to estimate their in-house level-of-effort beyond agreeing that the effort was "significant." Often, sites were able to re-assign existing staff to support the additional requirements, but frequently additional staff were needed.

Perhaps most important, there are *many* good approaches and models appropriate for individual libraries and systems.

The cost worksheet shown in Figure 1 can also be useful in the evaluation of public library Internet connectivity and services provision. A key factor that must be considered is the cost of various configurations in relationship to the quantity and quality of services provided. Very little is known, as yet, about the cost-benefit relationships of providing Internet-based services. Monitoring the costs of Internet connections and services will be essential if public libraries are to justify expenditures for such services. Although strategies have been suggested for user-based evaluation of networked information services (McClure, 1994), there is little research that costs and assesses the quality of networked services either as a stand-alone service or in comparison to traditional library services.

A final note on using these models and worksheets is that they offer a *general guide* to costs and connectivity configurations. Users of the worksheet and models may require additional information and education from network providers and others to use these models effectively. In addition, the cost categories and elements can change. The actual costs suggested here are in summer 1995 U.S. dollars and are certain to change over time, and the models can be easily modified and revised to take into consideration local circumstances. As suggested earlier in the text, the models are not mutually exclusive and will more than likely be "mixed and matched" to develop other configurations appropriate to a library's particular needs.

PLANNING YOUR INTERNET CONNECTION

Increasingly, successful strategies for Internet connectivity and services will require "approximation-based planning skills," that is, planning to the next point on the horizon where there is some degree of control, knowledge, and understanding of the conditions that will exist at that point. Because of the rapid changes in information technologies and their applications, these approximation points may be as little as six months into the future. While service objectives and library missions certainly can be stable for more than six months, Internet connectivity and services planning will need to be very fleet-footed.

One purpose of this paper is to assist library planners think about how their libraries can be connected to the Internet and to provide some indication of what various configurations will cost. The preparation of a complete planning manual is beyond the scope of this project. Works by Jacob (1990) and McClure, Owen, Zweizig, Lynch, and Van House (1987) are helpful tools for planning library services. In addition, the following suggestions may be helpful in this planning process:

- **Scan the library's environment.** How much community or trustee interest in the Internet and providing Internet service is evident? Are there some segments of the local community more interested than others? How can you obtain their support and involvement? What is the funding outlook?

- **Develop a vision for what the library's Internet connectivity and services should include.** This report should help, but read other books and magazines, visit other libraries offering Internet services, and talk to other librarians regarding their experiences. Think both short-term and long-term. Other sources of information are provided in the references section of this report.

- **Find a champion or be a champion.** The successful libraries visited by the study team generally rely on the efforts of one or a few highly committed individuals willing to expend the time and effort required to move the project forward.

- **Locate patrons, trustees, or other staff members who have the necessary technical expertise and recruit them to your effort.** Many libraries are too small to have their own staff knowledgeable in technical matters. Computer hobbyists (staff or patrons) can prove invaluable for technical planning and assisting staff and patrons with implementation and training.

- **The amount of formalized planning required to implement Internet connectivity clearly depends on the magnitude of the project attempted.** But regardless of the project size, it will be beneficial to formally identify significant tasks and milestones and assign responsibilities (both action and funding) for those tasks. Management interest, involvement, and approval is assumed.

- **Expect to need additional education and training**. Entering into the networked environment will require many librarians, trustees, and community members to upgrade their knowledge and skills related to computers, telecommunications, and networks. Obtain this knowledge and the appropriate skills.

- **Act**. The successful libraries we visited proceeded with some type of implementation even when they had unresolved issues concerning policies, training, and funding. If the managerial and funding support exists and technical assistance is available, certainly expend some time and effort planning your architecture and implementation. This will minimize the purchase and acquisition of soon-to-be-obsolete equipment. But if it is necessary to start small to start at all, do not worry about acquiring "the perfect" configuration. Just proceed!

Planning skills are as important as implementation skills. Indeed, we encountered a number of successful libraries in which the planning and implementation components of obtaining Internet connectivity and providing Internet services were inseparable. Equally important is a "can do" attitude and the ability to learn as you go. These skills and a good knowledge of Internet costs and cost models (as described above) can greatly contribute to being successfully connected to the Internet and providing Internet services.

The Internet and the emerging national networked environment provide unparalleled opportunities for public libraries to introduce new and innovative information services to their local as well as global communities. These opportunities also present a number of challenges in terms of how to plan for and implement Internet services. Librarians at the local level must take a leadership stance to expose their communities to the Internet. The models and cost worksheets offered in this report provide a means to help librarians make the Internet connection, provide networked-based services, and move into the global information infrastructure.

Appendix A

Research Methodology

Introduction

The study began on February 15, 1995 and was completed in May 1995. The methodology relied on a number of qualitative and quantitative data collection techniques to answer the following research questions:

- What are the general cost categories and specific cost elements within these categories related to public libraries connecting to the Internet and providing Internet-based services?
- Can models be developed that depict general costing approaches for connecting to the Internet and providing Internet-based services? If yes, what are these models?
- What local, situational, or otherwise unique factors could affect costs for public libraries to connect to the Internet and provide Internet-based services?

Answers to these questions will increase public librarians' and policymakers' knowledge of costs for public library connectivity and Internet-based services.

The study team utilized standard techniques for developing the research design and completing the data collection activities as outlined in Yin (1994), Krueger (1994), Marshall and Rossman (1995), Miles and Huberman (1994), and Creswell (1994). These techniques incorporated specific strategies to insure the collection of valid and reliable data. It is important to note that the models and cost worksheet are based on data from a number of sources but may not take into consideration specific situational-related factors unique to some public library settings.

Preliminary Costing Categories

Based on previous work of the study team, relevant literature, and discussions with several librarians in a variety of public libraries, the study team initially identified seven cost categories. These categories served to provide a beginning data collection and analysis framework. These cost categories were:

- Program planning and management
- Connectivity

- Facilities upgrades and maintenance
- Navigation and access
- Training and education
- Services
- Research, development, and evaluation.

From these beginning categories, the study team produced a final set of cost categories and elements as shown in Figure 1.

In producing the cost worksheet, the study team recognized that there exist both start-up and recurring costs (e.g., phone line installation costs and subsequent maintenance and usage charges) within these categories. In addition, public libraries incur different costs depending on whether they are providers or consumers of Internet/NII-based information. To the degree possible, the costing worksheet identifies and distinguishes between the initial, recurring, and service provider/consumer costs within each of the cost categories.

Data Collection

The study team employed a number of data collection techniques to address the above research questions. Initially, the study team reviewed data from previous studies related to this topic, monitored listservs such as PubLib-Net, reviewed an in-house database maintained at Syracuse University by the study team for cost-related information, and conducted preliminary interviews about the topic with knowledgeable individuals in the field. These initial efforts produced:

- A preliminary set of cost categories and elements that were then assessed and refined through a number of additional data collection efforts.
- A set of interview/discussion questions and issues used by the study team for site visits, interviews, and focus group sessions.

Once these items were developed, the study team developed a schedule of data collection activities.

The study team relied on a combination of in-person and phone interviews, focus groups, content analysis on participant-provided documentation, e-mail/mail surveys, and site visits. This variety of data collection techniques provided a rich set of cost data for public libraries that are developing Internet/NII connection programs.

To maximize the potential usefulness of the data collection efforts, the study team identified and contacted key personnel at data collection sites prior to beginning any data collection activity. Once contacted, the study team asked respondents to participate in one of a variety of data gathering activities appropriate to respondent and study team schedules and interest — phone interviews, focus groups, documented cost data, site visits, or e-mail/mail surveys. Based on these initial discussions, the study team established interview questions/topics, meetings, and schedules. For each data collection activity, the study team developed a data collection protocol designed to elicit the data necessary to answer the research questions outlined above.

Study Participants

The study team established the following criteria to identify appropriate public libraries for data collection:

- The national publicity generated by the public library Internet initiative, with particular interest in the initiative's integration of rural and urban patron needs
- The information available on the Internet through listservs and newsgroups describing the public library Internet initiative
- Study team knowledge of the public library Internet initiative
- Preliminary discussions and interviews with various public library Internet initiative administrators, project managers, and staff, indicating that these projects might be an appropriate site for the purpose of this study
- The ability of the library to participate in the study, assist in scheduling meetings, and meet with the study team.

All told, the study team collected data from the following sources:

- Three focus group sessions comprised of public librarians, state librarians, and other experts conducted at the 1995 Midwinter American Library Association annual conference;
- In-person and telephone interviews with five people involved in the federal policy making process;
- Site visits (for individual and group interviews and for obtaining project documentation), and follow-up phone interviews to:
  - a large urban public library
  - a large city/county public library system
  - two state networking initiatives
  - four rural and urban libraries of various sizes that are in one of the states where a site visit occurred.
- In-depth interviews with representatives from a rural consortium of small public libraries and a medium size urban public library.

The combination of data collection techniques from these various sources allowed the study team to compare and contrast the information obtained. Furthermore, the various data collection techniques informed additional data collection activities.

Study team members revised the cost worksheet (Figure 1) and the cost models as data collection progressed. Thus, these items were continually revised and improved during the project. In addition to these formal efforts to obtain feedback on the worksheet and the models, members of the study team presented the material at a number of professional meetings and obtained informal assessments that also improved the models and the worksheet.

Data Analysis

Each data collection activity resulted in a written report that summarized the objectives of the effort, the activities in which the study team members engaged, and the findings. The study team member collecting the data typically organized the findings in terms of:

- Aspects and issues that might inform the development of cost models
- Cost categories and elements
- Issues, barriers, and situational characteristics that might affect a library's use of a particular cost model.

In most instances, the study team met to discuss the data collection activity in light of the preliminary written report. Members of the study team then reviewed, edited, and critiqued a draft of the analyis. At this point, a study team member produced a final summary of the data collection activity.

For some site visits and group interviews, the study team was able to have the participants complete a version of the cost worksheet. The figures that the participants provided were then compared to others. In the analysis of these completed worksheets, study team members looked for trends, identified cost elements that were or were not provided, and considered the range of costs reported for particular costing elements.

Summary

The methodology used for this study relied on a combination of data collection activities, meetings with numerous public librarians, and an evolutionary approach to instrument design and administration. Findings from one data collection activity informed additional data collection strategies. Different data collection strategies were used to obtain cost information, develop cost models, and identify situational factors affecting cost decisions in that particular library. The study team used a number of opportunities to obtain feedback and ongoing assessment of the models and the cost worksheet from public librarians throughout the study.

Appendix B

Glossary of Internet Terms*

56K Line
A digital phone-line connection (leased line) capable of carrying 56,000 bits-per-second. At this speed, a Megabyte will take about 3 minutes to transfer. This is 4 times as fast as a 14,400bps modem. See also: Bandwidth, T-1.

ADN
(Advanced Digital Network) — Usually refers to a 56K/bps leased-line.

Archie
A tool (software) for finding files stored on anonymous FTP sites. You need to know the exact file name or a sub-string of it.

ARPANet
(Advanced Research Projects Administration Network) — The precursor to the Internet. Developed in the late 60's and early 70's by the US Department of Defense as an experiment in wide-area networking that would survive a nuclear war. See also: Internet (uppercase I).

Anonymous FTP
See FTP.

ASCII
(American Standard Code for Information Interchange) — this is the defacto world-wide standard for the code numbers used by computers to represent all the upper and lower-case latin letters, numbers, punctuation, etc. There are 128 standard ASCII codes each of which can be represented by a 7 digit binary number: 0000000 through 1111111.

BBS
(Bulletin Board System) — A computerized meeting and announcement system that allows people to carry on discussions, upload and download files, and make announcements without the people being connected to the computer at the same time. There are many thousands (millions?) of BBS's around the world, most are very small, running on a single IBM clone PC with 1 or 2 phone lines. Some are very large and the line between a BBS and a system like CompuServe gets crossed at some point, but it is not clearly drawn.

Bit
(Binary DigIT) — A single digit number in base-2, in other words, either a 1 or a zero. The smallest unit of computerized data. Bandwidth is usually measured in bits-per-second. See also Bandwidth, Byte, Kilobyte, and Megabyte.

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BITNET
(Because It's Time Network) — A network of educational sites separate from the Internet, but e-mail is freely exchanged between BITNET and the Internet. Listservs, the most popular form of e-mail discussion groups, originated on BITNET. BITNET machines are IBM VMS machines, and the network is probably the only international network that is shrinking.

Backbone
A high-speed line or series of connections that forms a major pathway within a network. The term is relative as a backbone in a small network will likely be much smaller than many non-backbone lines in a large network.

Bandwidth
How much "stuff" you can send through a connection. Usually measured in bits-per-second. A full page of english text is about 16,000 bits. A fast modem can move about 15,000 bits in one second. Full-motion full-screen video would require roughly 10,000,000 bits-per-second, depending on compression. See also: 56K, Bit, T-1.

Binhex
(BINary HEXadecimal) — a method for converting non-text files (non-ASCII) into ASCII. This is needed because Internet e-mail can only handle ASCII. See also: ASCII.

Browser
A client program (software) that is used to look at various kinds of Internet resources. See also: Client, URL, WWW.

Byte
A set of Bits that represent a single character. Usually there are 8 or 10 bits in a Byte, depending on how the measurement is being made.

Client
A software program that is used to contact and obtain data from a Server software program on another computer, often across a great distance. Each Client program is designed to work with one or more specific kinds of Server programs, and each Server requires a specific kind of Client. See also: Server.

Cyberspace
Term originated by author William Gibson in his novel "Neuromancer," the word Cyberspace is currently used to describe the whole range of information resources available through computer networks.

Domain Name
The unique name that identifies an Internet site. Domain Names always have 2 or more parts, separated by dots. The part on the left is the most specific, and the part on the right is the most general. A given machine may have more than one Domain Name but a given Domain Name points to only one machine. Usually, all of the machines on a given network will have the same thing as the right-hand portion of their Domain Names, e.g.,

gateway.gbnetwork.com
mail.gbnetwork.com
www.gbnetwork.com

and so on. It is also possible for a Domain Name to exist but not be connected to an actual machine. This is often done so that a group or business can have an Internet e-mail address without having to establish a real Internet site. In these cases, some real Internet machine must handle the mail on behalf of the listed Domain Name. See also: IP Number.

E-mail
(Electronic Mail) — Messages, usually text, sent from one person to another via computer. E-mail can also be sent automatically to a large number of addresses (Mailing List). See also: Listserv, Maillist.

Ethernet
A very common method of networking computers in a LAN. Ethernet will handle about 10,000,000 bits-per-second and can be used with almost any kind of computer. See also: Bandwidth, LAN.

FAQ
(Frequently Asked Questions) — FAQs are documents that list and answer the most common questions on a particular subject. There are hundreds of FAQs on subjects as diverse as Pet Grooming and Cryptography. FAQs are usually written by people who have tired of answering the same question over and over.

FDDI
(Fiber Distributed Data Interface) — A standard for transmitting data on optical fiber cables at a rate of around 100,000,000 bits-per-second (10 time as fast as Ethernet, about twice as fast as T-3). See also: Bandwidth, Ethernet, T-1, T-3.

FTP
(File Transfer Protocol) — A very common method of moving files between two Internet sites. FTP is a special way to login to another Internet site for the purposes of retrieving and/or sending files. There are many Internet sites that have established

publicly accessible repositories of material that can be obtained using FTP, by logging in using the account name "anonymous," thus these sites are called "anonymous ftp servers."

Finger
An Internet software tool for locating people on other Internet sites. Finger is also sometimes used to give access to non-personal information, but the most common use is to see if a person has an account at a particular Internet site. Many sites do not allow incoming Finger requests, but many do.

Gopher
A widely successful method of making menus of material available over the Internet. Gopher is a Client and Server style program, which requires that the user have a Gopher Client program. Although Gopher spread rapidly across the globe in only a couple of years, it is being largely supplanted by Hypertext, also known as WWW (World Wide Web). There are still thousands of Gopher Servers on the Internet and we can expect they will remain for a while. See also: Client, Server, WWW, Hypertext.

Host
Any computer on a network that is a repository for services available to other computers on the network. It is quite common to have one host machine provide several services, such as WWW and USENET. See also: Node, Network.

HTML
(HyperText Markup Language) — The coding language used create Hypertext documents for use on the World Wide Web. HTML looks a lot like old-fashioned typesetting code, where you surround a block of text with codes that indicate how it should appear, additionally, in HTML you can specify that a block of text, or a word, is "linked" to another file on the Internet. HTML files are meant to be viewed using a World Wide Web Client program, such as Mosaic. See also: HTTP, Hypertext, Mosaic, WWW.

HTTP
(HyperText Transport Protocol) — The protocol for moving hypertext files across the Internet. Requires a HTTP client program on one end, and an HTTP server program on the other end. HTTP is the most important protocol used in the World Wide Web (WWW). See also: Client, Server, WWW.

Hypertext
Generally, any text that contains "links" to other documents - words or phrases in the document that can be chosen by a reader and which cause another document to be retrieved and displayed.

IMHO
(In My Humble Opinion) — A shorthand appended to a comment written in an online forum, IMHO indicates that the writer is aware that they are expressing a debatable view, probably on a subject already under discussion. One of many such shorthands in common use online, especially in discussion forums.

IP Number
Sometimes called a "dotted quad". A unique number consisting of 4 parts separated by dots, e.g.,

165.113.245.2

Every machine that is on the Internet has a unique IP number - if a machine does not have an IP number, it is not really on the Internet. Most machines also have one or more Domain Names that are easier for people to remember. See also: Domain Name, Internet.

IRC
(Internet Relay Chat) — Basically a huge multi-user live chat facility. There are a number major IRC servers around the world which are linked to each other. Anyone can create a "channel" and anything that anyone types in a given channel is seen by all others in the channel. Private channels can (and are) created for multi-person "conference calls."

ISDN
(Integrated Services Digital Network) — Basically a way to move more data over existing regular phone lines. ISDN is only slowly becoming available in the USA but where it is available, it can provide speeds of 64,000 bits-per-second over a regular phone line at almost the same cost as a normal phone call.

Internet (upper case I)
The vast collection of inter-connected networks that all use the TCP/IP protocols and that evolved from the ARPANET of the late 60's and early '70s. The Internet now (Nov. 1994) connects roughly 30,000 independent networks into a vast global internet. See also: internet (lower case i)

internet (lower case i)
Any time you connect 2 or more networks together, you have an internet - as in inter-national or inter-state.

Kilobyte
A thousand bytes. Actually, usually, 1024 (2^10) bytes. See also: Byte, Bit.

LAN
(Local Area Network) — A computer network limited to the immediate area, usually the same building or floor of the building.

Leased-line
Refers to a phone line that is rented for exclusive 24-hour, 7-days-a-week use from your location to another location. The highest speed data connections require a leased line. See also: 56K, T-1, T-3.

Listserv
The most common kind of maillist . Listervs originated on BITNET but they are now common on the Internet. See also: BITNET, E-mail, Maillist.

Login
Noun or a verb. Noun: The account name used to gain access to a computer system. Not a secret (contrast with Password). Verb: The act of entering into a computer system, e.g. "Login to the WELL and then go to the GBN conference." See also: Password.

Megabyte
A million bytes. A thousand kilobytes. See also: Byte, Bit, Kilobyte.

MOO
(Mud, Object Oriented) — one of several kinds of multi-user role-playing environments, so far only text-based. See also: MUD, MUSE.

MUD
(Multi-User Dungeon or Dimension) — A (usually text-based) multi-user simulation environment. Some are purely for fun and flirting, others are used for serious software development, or education purposes and all that lies in between. A significant feature of most MUDs is that users can create things that stay after they leave and which other users can interact with in their absence, thus allowing a "world" to be built gradually and collectively. See also: MOO, MUSE.

MUSE
One kind of MUD - usually with little or no violence. See also: MOO, MUD.

Maillist (or Mailing List)
A (usually automated) system that allows people to send e-mail to one address, whereupon their message is copied and sent to all of the other subscribers to the maillist. In this way, people who have many different kinds of e-mail access can participate in discussions together.

Modem
(MOdulator, DEModulator) — a device that you connect to your computer and to a phone line, that allows the computer to talk to other computers through the phone system. Basically, modems do for computers what a telephone does for humans.

Mosaic
The best known and most widespread WWW browser or client software. The source-code to Mosaic has been licensed by several companies and there are several other pieces of software as good or better than Mosaic. See also: Browser, Client, WWW.

NIC
(Network Information Center) — Generally, any office that handles information for a network. The most famous of these on the Internet is the InterNIC, which is where new domain names are registered.

Network
Any time you connected 2 or more computers together so that they can share resources you have a computer network. Connect 2 or more networks together and you have an internet. See also: Internet, internet.

Newsgroups
The name for discussion groups on Usenet . See also: Usenet.

Node
Any single computer connected to a network . See also: Network, Internet, internet.

Packet Switching
The method used to move data around on the Internet. In packet switching, all the data coming out of a machine is broken up into chunks, each chunk has the address of where it came from and where it is going. This enables chunks of data from many different sources to co-mingle on the same lines, and be sorted and directed to different routes by special machines along the way. This way many people can use the same lines at the same time.

Password
A code used to gain access to a locked system. Good passwords contain letters and non-letters and are not simple combinations such as "virtue7." A good password might be:

Hot$1-6

See also: Login

POP
Two commonly used meanings: "Point of Presence" and "Post Office Protocol." A "Point of Presence" usually means a city or location where a network

can be connected to, often with dialup phone lines, so if an Internet company says they will soon have a POP in Belgrade, it means that they will soon have a local phone number in Belgrade, and/or a place where leased-lines can connect to their network. A second meaning, "Post Office Protocol" refers to the way e-mail software such as Eudora gets mail from a mail server. When you obtain a SLIP, PPP, or shell account you almost always get a POP account with it, and it is this POP account that you tell your e-mail software to use to get your mail. See also: PPP, SLIP.

PPP
(Point to Point Protocol) — most well known as a protocol that allows a computer to use a regular telephone line and a modem to make a TCP/IP connection and thus be really and truly on the Internet. PPP is gradually replacing SLIP for this purpose. See also: IP number, Internet, SLIP, TCP/IP.

RFC
(Request For Comments) — the name of the result and the process for creating a standard on the Internet. New standards are proposed and published on line, as a "Request For Comments." The Internet Engineering Task Force is a consensus-building body that facilitates discussion, and eventually a new standard is established, but the reference number/name for the standard retains the acronym "RFC," e.g. the official standard for e-mail is RFC 822.

Router
A special-purpose computer (or software package) that handles the connection between 2 or more networks. Routers spend all their time looking at the destination addresses of the packets passing through them and deciding which route to send them on. See also: Network, Packet Switching.

SMDS
(Switched Multimegabit Data Service) — A new standard for very high-speed data transfer.

Server (see Client)
A computer, or a software package, that provides a specific kind of service to client software running on other computers. The term can refer to a particular piece of software, such as a WWW server, or to the machine on which the software is running, e.g. "Our mail server is down today, that's why e-mail isn't getting out." A single server machine could have several different server software packages running on it, thus providing many different services to clients on the network. See also: Client, Network.

SLIP
(Serial Line Internet Protocol) — a standard for using a regular telephone line (a "serial line") and a modem to connect a computer as a real Internet site. SLIP is gradually being replaced by PPP. See also: Internet, PPP.

T-1
A leased-line connection capable of carrying data at 1,544,000 bits-per-second. At maximum theoretical capacity, a T-1 line could move a megabyte in less than 10 seconds. That is still not fast enough for full-screen, full-motion video, for which you need at least 10,000,000 bits-per-second. T-1 is the fastest speed commonly used to connect networks to the Internet. See also: 56K, Bandwidth, Bit, Byte, Ethernet, T-3.

T-3
A leased-line connection capable of carrying data at 45,000,000 bits-per-second. This is more than enough to do full-screen, full-motion video. See also: 56K, Bandwidth, Bit, Byte, Ethernet, T-1.

TCP/IP
(Transmission Control Protocol/Internet Protocol) — This is the suite of protocols that defines The Internet. Originally designed for the UNIX operating system, TCP/IP software is now available for every major kind of computer operating system. To be truly on the Internet, your computer must have TCP/IP software. See also: IP number, Internet, UNIX.

Telnet
The command and program used to login from one Internet site to another. The telnet command/program gets you to the "login:" prompt of another host.

Terminal
A device that allows you to send commands to a computer somewhere else. At a minimum, this usually means a keyboard and a display screen and some simple circuitry. Usually you will use terminal software in a personal computer - the software pretends to be ("emulates") a physical terminal and allows you to type commands to a computer somewhere else.

Terminal Server
A special purpose computer that has places to plug in many modems on one side, and a connection to a LAN or host machine on the other side. Thus the terminal server does the work of answering the calls and passes the connections on to the appropriate node . Most terminal servers can provide PPP or SLIP services if connected to the Internet. See also: LAN, Modem, Host, Node, PPP, SLIP.

UNIX

A computer operating system (the basic software running on a computer, underneath things like word processors and spreadsheets). UNIX is designed to be used by many people at the same time (it is "multi-user") and has TCP/IP built-in. It is the most common operating system for servers on the Internet.

URL

URL (Uniform Resource Locator) — The standard way to give the address of any resource on the Internet that is part of the World Wide Web (WWW). A URL looks like this:

http://www.matisse.net/seminars.html
or telnet://well.sf.ca.us
or news:new.newusers.questions

The most common way to use a URL is to enter into a WWW browser program, such as Netscape, or Lynx. See also: Browser, WWW.

Usenet

A world-wide system of discussion groups, with comments passed among hundreds of thousands of machines. Not all Usenet machines are on the Internet , maybe half. Usenet is completely decentralized, with over 10,000 discussion areas, called newsgroups.

Veronica

(Very Easy Rodent Oriented Net-wide Index to Computerized Archives) — Developed at the University of Nevada, Veronica is a constantly updated database of the names of almost every menu item on thousands of gopher servers. The Veronica database can be searched from most major gopher menus. See also: Gopher.

WAIS

(Wide Area Information Servers) — A commercial software package that allows the indexing of huge quantities of information, and then making those indices searchable across networks such as the Internet. A prominent feature of WAIS is that the search results are ranked according to how relevant the "hits" are, and that subsequent searches can find "more stuff like that last batch" and thus refine the search process.

WAN

(Wide Area Network) — Any internet or network that covers an area larger than a single building or campus. See also: Internet, internet, LAN, Network.

WWW (World Wide Web)

Two meanings - First, loosely used: The whole constellation of resources that can be accessed using Gopher, FTP, HTTP, telnet, Usenet, WAIS and some other tools. Second, the universe of hypertext servers (HTTP servers) which are the servers that allow text, graphics, sound files etc. to be mixed together. See also: Browsers, FTP, Gopher, HTTP, Telnet, URL, WAIS.

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